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Fire Management Notes

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Many thanks to **Donna Paananen**, editor, North Central Forest Experiment Station, East Lansing, MI, and **Enid Hodes**, editor, Public Affairs Office, Washington, DC, for their substantial help in editing this issue of *Fire Management Notes*.

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The Wyoming Smokebusters—a Viable Alternative

Robert W. Akers

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The Wyoming Smokebusters, a specially trained wildland firefighting handcrew of inmates helped to battle 12 fires in the Wyoming area—7 of which were initial attack fires—during the summer of 1991.

The Wyoming State Forestry Division and the Wyoming Department of Corrections for the past 27 years have combined efforts in developing and supporting a wildland firefighting handcrew manned by inmates originally from the Wyoming State Penitentiary for men in Rawlins. Called "Smokebusters," these crews have helped State, USDA Forest Service, U.S. Department of the Interior Bureau of Land Management and National Park Service, and county personnel with statewide fire suppression efforts.

The Smokebusters handle all aspects of firefighting, from initial attack to operating engines to mopping up and staffing the fire camp kitchen. The effort stretches back to 1964, when the State's first conservation camp, a mobile unit with six crew members, was established. Today, the 50-member crew works out of the Wyoming Honor Conservation Camp, a permanent camp in northeastern Wyoming. It has offered a viable alternative to foresters who needed to augment their crews and to inmates who had no security problems and were interested in a constructive, outdoor work detail.

A Brief History

1964-74. The State's first self-contained mobile conservation camp was established. The camp operated on State lands and parks in the eastern half of Wyoming. The crew—with six inmates, a correctional officer, and a State Forestry Division work supervisor—worked to conserve natural resources, giving top priority to fire suppression. The effort continued until 1974, when the camp closed because of a dwindling population at the penitentiary, making support difficult.

1975-79. With no camp out of which to base a crew, the penitentiary administration assembled firefighting crews as they were needed. Wyoming State Forestry staff transported and supervised these crews during fire suppression efforts. These crews were given a 1-day training session each year. Occasionally this training was carried out in conjunction with local forest seasonal crew training, but most of it came from hands-on experience.

1980-83. A second attempt was made to open a conservation camp. This camp was located 60 miles (96 km) southeast of the State penitentiary on the northern edge of the Snowy Range Mountains. Inmates were initially housed in large military squad tents. As the program progressed, the crew used mobile homes. The 5- to 15-member crew and the correctional officer traveled from the State penitentiary to the campsite every Monday morning, bringing enough food and supplies for the workweek. On Friday afternoons they returned to the penitentiary.

The crew thinned lodgepole pine timber stands on State lands and salvaged and peeled posts and corral poles, which were used by the Wyoming Recreation Commission and the Wyoming Game and Fish Department. During this period, the inmate firefighting crew was used primarily for fire mopup, a decision that was made based on the crew's limited training (1 day a year) and lack of equipment. Limited financial support and a camp location that was unfavorable to year-long operation resulted in the camp's closing in late 1983.

1984-88. Penitentiary support for firefighting continued, but training was stepped up. Two Wyoming State Forestry Division employees taught one or two classes a year for inmates who volunteered to fight forest fires. Classes now spanned 3 days. The first 2 days combined classroom instruction and handline construction practice. The final day was devoted to step testing. No inmates were allowed to participate on the firefighting handcrew until they successfully passed the step-test. Each year, 30 to 50 inmates were trained for wildland fire suppression. Crews began to develop pride in providing a professional, quality job.

1989-Present. Plans were made to fund and build a permanent conservation camp. After key personnel from the Wyoming State Forestry Division and the Wyoming Department of Corrections toured and reviewed the Nevada Conservation Camp program in January 1988, the Wyoming State Legislature allocated funds to construct and operate a permanent conservation camp. This camp of 50 men is located in Newcastle, northeastern Wyoming.

Wyoming Honor Conservation Camp at Newcastle, WY.

Corrections and Forestry Collaborate

The camp currently operates under the following mission statement: "Wyoming Honor Conservation Camp is first and foremost a part of the Wyoming Department of Corrections, making its primary function to give the more progressive inmates at the Wyoming State Penitentiary an opportunity to come to the Wyoming Honor Conservation Camp where they can prepare for a respectable and productive life in society. At the same time, we will provide a safe environment for residents, staff, and the community."

Although the inmates' care and the facility's operation are solely the responsibility of the Wyoming Department of Corrections, the Wyoming State Forestry Division has a vested interest in the camp and supervises all field work and projects. These projects include work for State, city, county, and Federal agencies if it is within 11/2-hours' traveltime of the camp and does not compete with private enterprise.

The forestry support staff includes a program manager and four crew supervisors. At capacity, each supervisor manages an eight-member crew. The same 32 residents are trained each spring for wildland fire suppression. The other 18 residents are divided among kitchen, janitorial, and maintenance crews.

Community and State Projects

The special crew gives priority to firefighting, but switches to forestry and conservation projects when they're not needed for firefighting missions. The forestry work crews have been widely accepted in the community. During fiscal year 1991, the forestry crews completed 82 projects for 16 different agencies. They worked on State land to improve timber stands, salvage posts and firewood, burn slash, and construct fire breaks.

At the community level, projects included painting and maintenance for the local museum and transplanting trees for the Newcastle Beautification Committee, the Governor's Mansion in Cheyenne, and the Wyoming Fire Academy. The crews also provided disaster assistance to the local airport after a hangar was leveled by heavy winds. They pruned trees and painted fences at the county fairgrounds and cleaned up litter at the local landfill.

When staffing at the permanent conservation camp was getting underway, it was decided that a more positive title would be associated with the inmate firefighting crew. Instead of the traditional terms "prison crew," "con crew," or "inmate squad," the name Wyoming Smokebusters was adopted.

On the Fireline

The Smokebusters are fully equipped with safety and fireline equipment needed to fight wildland fires. With the training they receive, the all-male crew is qualified as a Type II handcrew as defined under the National Wildfire Coordinating Group standards. Their training includes S-130 (Basic Firefighter), S-190 (Introduction to Fire Behavior), S-211 (Pumps and Water Use), S-212 (Power Saws), Basic First Aid, Standards for Survival, and Basic Helicopter and Aircraft Safety. What they learn is then reinforced through experience on prescribed burning projects on State lands each spring.

The State of Wyoming pays the inmates $40-95 a month for the daily

The Wyoming Smokebusters control spot fire on the 1991 Dull Knife prescribed burn, a combination training effort and prescribed fire burning in the Bighorn Mountains, in which the Bureau of Land Management, Forest Service, Wyoming Forestry Division, and county volunteer firefighters participated.

project work. They also receive additional incentive pay ranging from 60 cents to $1.50 an hour for fires, depending on their training and their fire experience.

Since 1964, these firefighting crews have been allowed to assist in fire suppression activities inside the State of Wyoming or on boundary fires, but they could not be dispatched to fires in other States. Early in 1991, approval was granted to use the Smokebuster firefighting crew in the Black Hills area of South Dakota.

Before going on an out-of-State dispatch, each crew member is required to sign a waiver of extradition before he is allowed to participate. Out-of-State dispatches are operating on a trial basis, and, if everything runs smoothly, plans are to expand the procedure to any State adjoining Wyoming.

The Wyoming Smokebusters put out hot spot on 1991 Canyon Creek Fire.

A Look at the Record

Smokebusters assisted with fire suppression efforts on 12 fires during the summer of 1991. Seven of them were initial attack fires. Vern Bentley, Medicine Bow National Forest, Laramie, WY, District, Division Group Supervisor on the Canyon Creek Fire (Cody, WY), asserts, "The Smokebuster crew ranks with some of the better crews I have ever worked with. They are safe, organized, and have a fantastic attitude. I am looking forward to working with them again."

Mark Rogers, Wyoming Interregional Crew Coordinator, was on the same Canyon Creek Fire and says, "The Wyoming Smokebusters are a well-trained and well-supervised crew. I always look forward to working with them." ■

Thanks,
Smokey

Improving a Prescribed Natural Fire Program: The Northern Region's Approach

Walt Tomascak

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Before the 1988 fire season, 4.8 million acres (1,942,560 ha) of wilderness and nonwilderness lands in the Northern Region were managed to allow the use of prescribed natural fire. But in the aftermath of severe fires in the Greater Yellowstone Area and the Bob Marshall Wilderness Complex in 1988, the Chief of the USDA Forest Service put all Forest Service prescribed natural fire programs on "hold" until each fire plan allowing their use was reviewed.

These reviews were intended to determine if all existing fire management direction was being met and to see that any new direction resulting from the "Final Report on Fire Management Policy," conducted by the Secretaries of the U.S. Departments of Agriculture and the Interior, was incorporated.

The Northern Region's prescribed natural fire program had been one of the most active in the USDA Forest Service—378 prescribed natural fires treating over 180,000 acres (72,846 ha) between 1972 and 1988. During that period, nine fires had to be classed as wildfires after some element of the prescription had been exceeded. Eight of those fires had relatively insignificant impacts. But one, the 1988 Canyon Creek Fire in Montana, was very significant, resulting in a large amount of burned acreage outside the area designated for prescribed natural fire.

Impetus for Improvement

Prescribed natural fires are intended to replicate what would normally take place in nature. The severity of the 1988 fire season, however, prompted a reevaluation of the practice and a quest for better procedures.

The lessons learned during the 1988 season resulted in a major effort to improve the prescribed natural fire program at the national, regional, and forest levels. Highlighted here are the most important changes undertaken by the Northern Region.

Before 1988, a forest supervisor or district ranger had a very short time in which to make a fire management decision that was mandated to remain in effect for as long as 60 to 70 days. Some basic information was collected in an incident plan, but there was no formal procedure to document the line officer's approval of the plan. If a decision had to be reversed later and a prescribed natural fire declared a wildfire, a stigma of failure was associated with the fire.

Since 1990, some new tools were introduced and new procedures implemented to benefit forest officers who manage prescribed natural fires. For example, the decisionmaking process was broken down into two stages that can be realistically met by field managers.

Initial Assessment Checklist. In Stage 1, fire conditions are evaluated against some basic criteria and risk assessment factors. The evaluation must be completed within 2 hours of a fire's detection. The timeframe must be kept short so an ignition can be swiftly attacked, minimizing emergency fire suppression expenditures in case the ignition is declared a wildfire.

The field manager answers a checklist of questions to evaluate basic criteria. Examples are:

- Is the fire caused by lightning or humans?
- Is it a threat to life or property?
- What is its proximity to the boundary of the area?
- What is the regional preparedness level?
- Are the drought indexes (Palmer Drought Index, Keetch-Byram Drought Index) and the Energy Release Component acceptable?
- Are resources available to manage the prescribed natural fire?
- Is the air quality acceptable?
- Is funding available?

When the Stage 1 evaluation is completed, a recommendation is made to the responsible line officer to either declare the ignition a wildfire or declare it a conditional prescribed natural fire and proceed with the Stage 2 evaluation.

Burn Plan. The Stage 2 evaluation involves a team of resource managers completing a formal burn plan. A few key requirements of the burn plan are:

- A delineation of the maximum allowable perimeter (MAP). The MAP is management's expression of the maximum area that can be burned without unacceptable adverse effects on the wilderness resource, wilderness users, private property, or private resources bordering the wilderness. It also is an assessment of whether the fire has gone beyond the ability of the fire manager to manage the situation. Once the fire exceeds the MAP, it is no longer a desirable event and must be declared a wildfire.
- A projection of fire growth during the remainder of the fire season given a normal weather pattern and a normal end to the fire season.

- A projection of fire growth during the remainder of the fire season given a severe weather pattern and a longer than normal season.
- A holding plan that addresses the areas representing the greatest threat to the MAP boundary and the actions needed to keep the fire from breaching the perimeter. Provisions to protect any special features, such as administrative sites or inholdings, are included along with a cost estimate for executing the entire holding plan.
- A comprehensive analysis of the effects of the fire on the various resources (including air quality) and the social and political implications of the fire inside and outside the wilderness.
- Provisions for daily revalidation by the approving line officer. Each prescribed natural fire must be revalidated once a day to ensure it continues to meet all assumptions outlined in the original burn plan.
- An analysis of how new fire starts within an existing prescribed natural fire MAP will be handled.

The team has up to 72 hours from discovery of the burn to complete the burn plan preparation process. A recommendation is then forwarded to the appropriate line officer for a decision. If the line officer is satisfied with the results projected from the burn plan and the risks involved, he or she will approve the plan. However, if some aspect of the plan points out a risk unacceptable to the line officer, he or she may, at that point, declare it a wildfire and take the most appropriate suppression action.

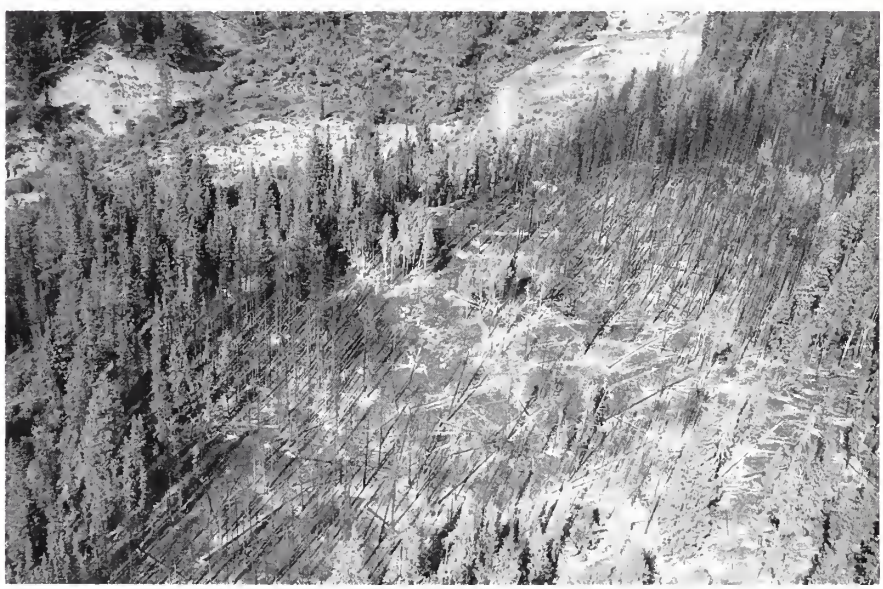
Administrative Overlaps. Prescribed fires occasionally overlap administrative boundaries. In some cases, the MAP may involve more than one ranger district, national forest, region, or even agency. When that happens, all line officers responsible for managing the lands within the MAP must approve the burn plan, ensuring that coordination takes place in the early stages of a prescribed natural fire.

A look at how one Forest Service region improved its prescribed natural fire program.

Funding Factors

Funding of the program is critical. The Northern Region uses a prescribed natural fire account administered from the regional office. The account is made up of fire, wildlife, and wilderness dollars and stands at approximately $100,000 for 1992. When a forest experiences a prescribed natural fire, the total cost of management (as projected from the burn plan) is reserved for that fire. When all funds available are committed, the fund is considered depleted and subsequent ignitions are declared wildfires unless the forest supervisor chooses to use forest funds to finance the burn plan.

Funds from the prescribed natural fire account will not actually be transferred to the forest until they are needed to manage the fire. Historical records indicate that only one prescribed natural fire in three exceeds 10 acres (4 ha), so most fires will not require spending the full amount of funds indicated in the burn plan. This circumstance is not a reflection of



A closeup of a 1988 Gates Park prescribed natural fire mosaic on the Lewis and Clark National Forest.

poor planning but is rather an indication of the conservatism of the burn plan coupled with the variability of weather and burning conditions during the course of the fire season.

Getting Wilderness Managers More Involved

The Northern Region has emphasized involvement of wilderness managers in the program. It has also provided training for both wilderness managers and fire personnel in the management of prescribed natural fires. A regional prescribed natural fire management course has been conducted in the Northern Region over the past 3 years, attracting 115 trainees. Interest has been strong, and several other regions and agencies have sent trainees to the sessions. Also, a national-level course was offered in 1991 and 1992 at the National Advanced Resource Technology Center at Marana, AZ.

Strong support from former Regional Forester John Mumma enabled the Northern Region to get back into the prescribed natural fire program after the trauma of 1988. The 1990 field season was the first year the program was reimplemented in the Frank Church-River of No Return Wilderness, Selway Bitterroot Wilderness, and a portion of the Bob Marshall Wilderness Complex. That year, the region experienced 18 prescribed natural fires and had approximately 650 acres (263 ha) treated by prescribed natural fire. In 1991, the rest of the Bob Marshall Wilderness Complex rejoined the program. Total activity in the Northern Region during that year was 32 prescribed natural fires burning over 7,200 acres (2,913 ha). The Absaroka Beartooth Wilderness in the Greater Yellowstone Area and the Anaconda Pintler Wilderness are expected to be back in the program by 1993.

Putting Changes to the Test

The past two seasons gave Northern Region program managers an opportunity to test the changes in decisionmaking and operating procedures that grew out of the USDA-USDI "Final Report on Fire Management Policy" and the Forest Service's "Report of the Task Force on Prescribed Fire Management Criteria." Some of the scenarios that prescribed natural fire managers have had to face during that period have been challenging. They included the following:

- Having enough qualified people to manage a prescribed natural fire throughout its life.
- Ensuring that a line officer is available to make the Stage 1 and Stage 2 decisions.
- Having a fire exceed its MAP and consequently be declared a wildfire.
- Experiencing a long, hot, dry fall season that tests the "most severe" fire projection made for a prescribed natural fire.
- Having to implement the holding plan on a prescribed natural fire to prevent it from exceeding the allowable perimeter.
- Addressing smoke management concerns on new starts within the plan area when several other prescribed natural fires are already burning.

All of these challenges were successfully dealt with by using the procedures outlined in the revised prescribed natural fire plans.

Managed Fire Approach

Both inside and outside the Forest Service many people erroneously view this program as a "let burn policy," implying that managers take a callous approach to fire. Prescribed natural fires, in fact, are not allowed to burn freely without consideration for where they are going or what impact they are having.

The staff on forests that have prescribed natural fire programs definitely are "managing" these fires. For example, the fires are monitored by either fixed lookouts or aircraft, and daily decisions are made to ensure the fires are meeting objectives outlined in each prescribed natural fire burn plan. Occasionally, holding actions will need to be taken to ensure those objectives continue to be met. When it is no longer possible for the prescribed natural fire to meet the established objectives, then it will be declared a wildfire and firefighters will take the most appropriate suppression action.

Although it will never be possible to remove all risk from a prescribed natural fire program, the Northern Region feels it has learned from the 1988 experiences. It has used this knowledge to improve operating procedures. As a result, the region has grown in its capacity to manage this complex program in a highly professional way. ■

LCES—a Key to Safety in the Wildland Fire Environment

L—Lookout(s)
C—Communication(s)
E—Escape routes
S—Safety zone(s)

LCES—a System for Operational Safety. In the wildland fire environment, where four basic safety hazards confront the firefighter—lightning, fire-weakened timber, rolling rocks, and entrapment by running fires—LCES is key to safe procedure for firefighters. LCES stands for "lookout(s)," "communication(s)," "escape routes," and "safety zone(s)"—an interconnection each firefighter must know. Together the elements of LCES form a safety system used by firefighters to protect themselves. This safety procedure is put in place before fighting the fire: Select a lookout or lookouts, set up a communication system, choose escape routes, and select safety zone or zones. (See diagram.)

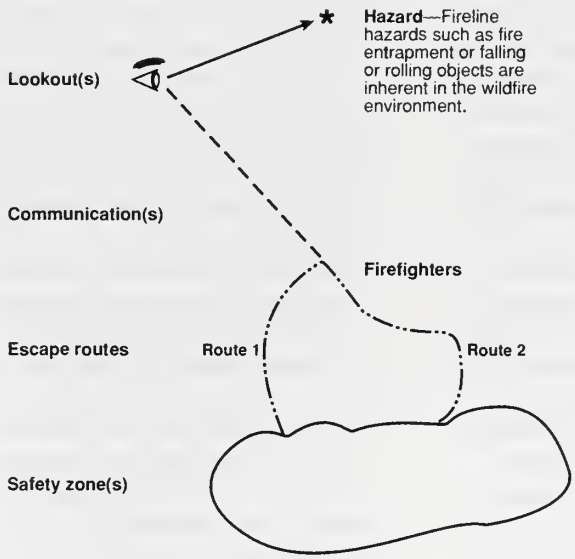
In operation, LCES functions sequentially—it's a self-triggering mechanism: Lookouts assess—and reassess—the fire environment and communicate to each firefighter threats to safety; firefighters use escape routes and move to safety zones. Actually, all firefighters should be alert to changes in the fire environment and have the authority to initiate communication.

Key Guidelines. LCES is built on two basic guidelines:

- Before safety is threatened, each firefighter must be informed how the LCES system will be used.
- The LCES system must be continuously reevaluated as fire conditions change.

How To Make LCES Work

- Train lookouts to observe the wildland fire environment and to recognize and anticipate fire behavior changes.
- Position lookout or lookouts where both the hazard and the firefighters can be seen. (Each situation—the terrain, cover, and fire size—determines the number of lookouts that are needed. As stated before, every firefighter has both the authority and responsibility to warn others of threats to safety.)
- Set up communications system—radio, voice, or both—by which the lookout or lookouts warn firefighters promptly and clearly of approaching threat. (Most often the lookout initiates a warning that is subsequently passed down to each firefighter by "word-of-mouth." It is paramount that every firefighter receive the correct message in a timely manner.)
- Establish the escape routes (at least two)—the paths the firefighters take from threatened position to area free from danger—and make them known. (In the Battlement Creek 1976 fire, three firefighters lost their lives after retreat along their only escape route was cut off by the advancing fire.)
- Reestablish escape routes as their effectiveness decreases. (As a firefighter works along the fire perimeter, fatique and distance increases the time required to reach a safety zone.)
- Establish safety zones—locations where the threatened firefighter may find adequate refuge from the danger. (Fireline intensity, air flow, and topographic location determine a safety zone's effectiveness. Shelter deployment sites have sometimes been termed, improperly and unfortunately, "safety zones." Safety zones should be conceptualized and planned as a location where no shelter will be needed. This does not imply that a shelter should not be deployed if needed, only that if there is a deployment, the safety zone location was not truly a safety zone.)



A Final Word

The LCES system approach to fireline safety is an outgrowth of my analysis of fatalities and near-misses for over 20 years of active fireline suppression duties. LCES simply refocuses on the essential elements of the standard FIRE ORDERS. Its use should be automatic in fireline operations. All firefighters should know LCES, the Lookout-Communication-Escape routes-Safety zone interconnection.■

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The Evolution of National Park Service Fire Policy[1]

Jan W. van Wagtendonk

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Fire policies in the National Park Service (NPS) have evolved from no management at all, through the full suppression of all fires, to the sophisticated application of scientifically based fire management strategies. When Yosemite Valley was set aside as a State reserve in 1864 and Yellowstone as a national park in 1872, there were no efforts to control fires. An era of full fire suppression began when management of Yellowstone passed to the U.S. Army in 1886 and to NPS in 1916. Experimental prescribed burning was first conducted in Everglades National Park in 1951. The Leopold Report (the 1963 report of the Leopold Committee, a special NPS wildlife management committee) influenced NPS to reevaluate its fire policies. Revisions to the policies completed in 1968 permitted the use of fire as a management tool and led to the creation of the first wilderness fire management program in Sequoia and Kings Canyon National Parks. To date, more than 2,000 lightning fires have been allowed to burn under carefully monitored conditions in 46 parks, and more than 1,000 prescribed burns have been set in 58 parks to meet management objectives. The Greater Yellowstone Area (the Yellowstone National Park and surrounding national forests) fires in 1988 led to an examination of NPS fire policy, which affirmed current policy but recommended refinements in implementation.

The Era of Fire Suppression

In 1864, President Lincoln set aside Yosemite Valley and the Mariposa Grove of sequoias as a State reserve. This was the first Federal Government action specifically designating an area for preservation and is considered by many to mark the beginning of the national park idea. Although the Native Americans who occupied the Yosemite region had for at least 4,000 years (Riley 1987) used fire for many cultural purposes, it is doubtful that they practiced any fire suppression. Early Euro-American settlers in the Yosemite region used fire to clear land and to improve grazing for sheep and cattle. Their only fire suppression efforts were directed toward protecting structures. The State reserve employed only one guardian, who had little time to fight fires.

When Yellowstone and Yosemite were designated as national parks in 1872 and 1890, respectively, no agency was assigned responsibility for their administration, and their new status did not result in the implementation of fire management. Although there were no fire management policies or activities during these early years, the stage was set for the beginnings of fire suppression.

The U.S. Army Years. The U.S. Army was assigned the responsibility for managing Yellowstone in 1886 and Yosemite and Sequoia in 1891. The policy of suppressing all fires began in Yellowstone in 1886 (Agee 1974) and was soon followed by similar policies in the other two national parks. The Army built extensive trail systems to facilitate patrolling the new parks for sheep and timber trespass and for wildfires. As new parks were established, the Army assumed control and dispatched the troops to extinguish all fires. Although there are few records of the Army's efforts, fire scars were formed less frequently during this period (Kilgore and Taylor 1979). This could be interpreted to mean either that there were few fires or that the Army was successful in extinguishing those that did occur.

The Years of Forest Service Influence. When NPS was established in the U.S. Department of the Interior in 1916, administration of the parks passed into civilian hands. Many of the personnel who had previously served in the Army switched uniforms and became the first park rangers. Although they carried with them the lessons and experience of fire suppression, they had little formal training in fire control. Professional guidance of the fire program came from the Forest Service in the U.S. Department of Agriculture (Pyne 1982). Established as a separate agency in 1905, the Forest Service had developed both a theoretical basis for systematic fire protection and considerable expertise in executing that theory in its management of National Forest System lands. The suppression of all fires became the official policy of the new NPS.

Since many of the parks established after 1916 were originally parts of national forests, NPS inherited an infrastructure of fire control facilities and equipment. Fire stations, lookouts,

[1]Jan W. van Wagentonk's article, "The Evolution of National Park Service Fire Policy," slightly revised here, first appeared in "Fire and the Environment: Ecological and Cultural Perspectives," a proceedings of an international symposium held in Knoxville, TN, on March 20-24, 1990, published by the Southeastern Forest Experiment Station in 1991 in Asheville, NC, as Gen. Tech. Rep. SE-69.

and trails were already in place. In addition, many of the new park rangers came from the Forest Service and had forestry and fire backgrounds (Pyne 1982). The Forest Service and NPS joined together to form the Forest Protection Board, which advised agencies on fire policy and standards.

Although NPS developed a separate fire control organization, it relied heavily on the Forest Service for expertise, personnel, and equipment. Mutual-aid agreements allowed the two agencies to respond to fires across boundaries and to share training and dispatching facilities. In most cases, however, the exchange was in the direction of the fledgling NPS.

The Civilian Conservation Corps Years. Professional fire protection began in the NPS with the establishment of the Civilian Conservation Corps (CCC) in 1933. A massive influx of personnel made it possible to expand firefighting facilities and deploy suppression forces throughout the parks. During the first 10 years, the fire staff went from a single national fire officer, a special crew at Glacier National Park, and a fire guard at Sequoia to an organization of some 650 CCC camps, totalling 7,000 employees (Pyne 1982).

NPS's fire policy was still identical with that of the Forest Service, which in 1935 adopted a policy of extinguishing any fire during the first burning period or, if that were not possible, by 10:00 a.m. the following day. Strict adherence to this policy required quick response time and numerous crews. Efforts were also directed toward developing better access to further reduce response times.

National Park Service policies concerning fire have changed over the years from no policy at all in the early years, through years of absolute fire suppression, to a period of experimentation and refinement with a full spectrum of integrated fire management strategies.

During this period, NPS greatly professionalized its approach to fire protection. Vegetation and fuel hazard maps were prepared from field surveys and response zones were delineated. Complete fire records were kept; each fire's cause and behavior were described, and the measures necessary to control each fire were detailed. These records did describe occasional large fires that might have exceeded the capabilities of the suppression forces.

The War and Postwar Years. World War II caused a decline in fire protection throughout the Nation. Skeleton crews were kept on to protect resources necessary for the war effort. NPS crews were practically nonexistent, although the fire records show that fires were still being suppressed successfully.

Demobilization after the war brought a new and different kind of influx to the firefighting agencies. Although the Forest Service had used bulldozers and smokejumpers before the war, airplanes, helicopters, tanks, and parachutes were products the war effort had refined and now available to fight the war against fire. Retardant drops, helitack crews, bulldozers, and smokejumpers became the new tools of choice (USDA Forest Service 1960). NPS relied heavily on the Forest Service for this new technology and shared support of aircraft and a smokejumper base at Yellowstone (Pyne 1982). The resulting firefighting force was very effective in continuing the policy of full fire suppression.

The Era of Fire Management. The effectiveness of fire protection was partly responsible for the beginnings of an NPS shift in policy from fire control to fire management. As had long been recognized in the South, the absence of fire from an ecosystem that has evolved with fire can lead to unexpected, and often undesirable, results. Specifically, researchers found that periodic fires reduced accumulations of woody and brushy fuels and thinned thick understories of shade-tolerant species. Without fire, species composition shifted and fuel accumulations increased.

The Years of Revelation. Although the NPS's first experiments with the use of fire occurred in Everglades National Park in 1951 (Robertson 1962), impetus for a change in policy came later from outside researchers in California. As early as 1959, Dr. Harold H. Biswell of the University of California at Berkeley advocated the use of prescribed fires to reduce the accumulation of debris underneath ponderosa pine stands in the Sierra Nevada of California (Biswell 1959). His work was expanded upon by Dr. Richard Hartesvelt of San Jose State University, who concluded that the greatest threat to the giant sequoia groves was not trampling by humans, but was catastrophic fire burning through understory thickets and unnaturally

high accumulations of fuel (Hartesvelt 1962).

In 1962, the Secretary of the Interior asked a committee to look into wildlife management concerns in the national parks. This committee, named after its chair, Dr. A. Starker Leopold, did not confine its report to wildlife, but took a broader ecological view that parks should be managed as ecosystems (Leopold and others 1963). They recommended that the biotic associations within a park be maintained or recreated as nearly as possible in the condition that prevailed when first visited by Euro-Americans. The report stated an often quoted passage:

> When the forty-niners poured over the Sierra Nevada into California, those that kept diaries spoke almost to a man of the wide-spaced columns of mature trees that grew on the lower western slope in gigantic magnificence. The ground was a grass parkland, in springtime carpeted with wildflowers. Deer and bears were abundant. Today much of the west slope is a dog-hair thicket of young pines, white fir, incense cedar, and mature brush—a direct function of overprotection from natural ground fires. Within the four national parks—Lassen, Yosemite, Sequoia, and Kings Canyon—the thickets are even more impenetrable than elsewhere. Not only is this accumulation of fuel dangerous to the giant sequoias and other mature trees but the animal life is meager, wildflowers are sparse, and to some at least the vegetation tangle is depressing, not uplifting. Is it possible that the primitive open forest could be restored, at least on a local scale? And if so, how? [Leopold and others 1963.]

It was not a coincidence that Dr. Leopold's office was just across the street from Dr. Biswell's. In fact, these gentlemen often discussed the ecological ramifications of fire exclusion over lunch and during seminars. Nor is it surprising that their graduate students would pursue fire-related Ph.D. dissertation topics and become NPS scientists (Kilgore 1968; van Wagtendonk 1972; Agee 1973; Graber 1981). The intellectual atmosphere at Berkeley invited students to challenge conventional approaches and practices.

The Turning Point. Only in 1968, after several false starts, was the Leopold Committee report incorporated into policy. First the Secretary of the Interior had to find out whether or not the report's findings were acceptable to the public. A department underling was sent to the meeting where the report was being presented and found it to be overwhelmingly supported. NPS was then directed to incorporate the report into its management policies. The entire report was included as an appendix and the section on fire management revised to reflect the new thinking (USDI National Park Service 1968). For the first time since 1916, NPS viewed fire as a natural process rather than as a menace:

> The presence or absence of natural fire within a given habitat is recognized as one of the ecological factors contributing to the perpetuation of plants and animals to that habitat.
>
> Fires in vegetation resulting from natural causes are recognized as natural phenomena and may be allowed to run their course when such burning can be contained within predetermined fire management units and when such burning will contribute to the accomplishment of approved vegetation and/or wildland management objectives.
>
> Prescribed burning to achieve approved vegetation and/or wildland objectives may be employed as a substitute for natural fire. [USDI National Park Service 1968.]

The Years of Experimentation. As is often the case with the NPS, a policy change led to experimentation. A prescribed natural fire program was initiated in Sequoia and Kings Canyon National Parks in 1968 (Kilgore and Briggs 1972), as were concurrent research studies of prescribed burns (Kilgore 1971; Parsons 1976). At Yosemite National Park, a similar prescribed natural fire program was started in 1972 (van Wagtendonk 1978), and research concentrated on refining techniques for prescribed burning (van Wagtendonk 1974; van Wagtendonk and Botti 1982). Experimental burns were ignited in several national parks, and Yellowstone and a few other parks established prescribed natural fire zones (Romme and Despain 1989).

The Years of Policy Refinement. As experience with both prescribed burning and prescribed natural fire programs increased, interim guidelines

were issued. Research also continued to contribute to the growing body of knowledge on both fire ecology and fire use. Contrary to Pyne's (1982) assertion, NPS was a leader in the development of prescribed natural fire techniques. Although NPS personnel cooperated with Forest Service managers and researchers in the same field, they did not need to look to the Forest Service for leadership.

The first revision of the 1968 fire policy came out in 1978 when all management policies for the NPS were rewritten (USDI National Park Service 1978). The policy stated:

> Fire is a powerful phenomenon with the potential to drastically alter the vegetative cover of any park.
>
> The presence or absence of natural fires within a given ecosystem is recognized as a potent factor stimulating, retarding or eliminating various components of the ecosystem. Most natural fires are lightning-caused and are recognized as natural phenomena which must be permitted to continue to influence the ecosystem if truly natural systems are to be perpetuated.
>
> Management fires, including both prescribed natural fires and prescribed burns, are those which contribute to the attainment of the management objectives of the park through execution of predetermined prescriptions defined in detail in the Fire Management Plan, a portion of the approved Natural Resources Management Plan.
>
> All fires not classed as management fires are "wildfires" and will be suppressed. [USDI National Park Service 1978.]

The policy further described the conditions under which fire could be used and specified that any management fire would be suppressed if it posed a threat to human life, cultural resources, physical facilities, or threatened or endangered species or if it threatened to escape from predetermined zones or to exceed the prescription.

The Forest Service was also revising its fire policy to embrace fire management rather than fire control (DeBruin 1974). In 1978 it abandoned the 10:00 a.m. policy in favor of a new one that encouraged the use of fire by prescription. The Forest Service's policy was also preceded by experimentation and research.

Thus, after a period of 10 years, policies of both the NPS and the Forest Service recognized the ecological role of fire and provided for its use. Pyne (1982) states, "Guided by the dazzling philosophy of the Leopold Report, the Park Service had advanced a policy too far ahead of its knowledge and technical skills; the Forest Service, with expertise and information in abundance, lagged in policy." While not entirely correct, his statement does point out the distinctive and synergistic roles the two agencies play.

In 1986, the Wildland Fire Management Guideline (NPS-18) was issued. It outlined in detail the procedures and standards to be used to manage wildfires, prescribed natural fires, and prescribed burns in the national parks (USDI National Park Service 1986). With regard to prescribed natural fires, the new guideline specified that the condition limits under which naturally ignited fires would be permitted to burn must be clearly stated. In addition, the ultimate size and boundaries of the fires must be preplanned and stated. Parks were also required to monitor each fire and to assess each burning day whether or not the fire should be allowed to continue to burn unimpeded.

Although there were no apparent problems with NPS's fire policies, they were revised again in March of 1988 as part of a 10-year comprehensive review of the management policies (USDI National Park Service 1988). The new policy emphasizes management objectives and plans:

> Fire is a powerful phenomenon with the potential to drastically alter the vegetative cover of any park. Fire may contribute to or hinder the achievement of park objectives. Park fire management programs will be designed around resource management objectives and the various management zones of the park. Fire-related management objectives will be clearly stated in a fire management plan, which is prepared for each park with vegetation capable of burning, to guide a fire management program that is responsive to park needs.
>
> All fires in parks are classified as either prescribed fires or wildfires. Prescribed fires include fires deliberately set by managers (prescribed burns) or fires of natural origins permitted to burn under prescribed

conditions (prescribed natural fires) to achieve predetermined resource management objectives. To ensure that these objectives are met, each prescribed fire will be conducted according to a written prescription. All fires that do not meet the criteria for prescribed fires are wildfires and will be suppressed. [USDI National Park Service 1988.]

The Post-Yellowstone Era

The fires of the Greater Yellowstone Area during the summer of 1988 brought fire policies of the NPS and the Forest Service under close scrutiny. The Secretary of Agriculture and the Secretary of the Interior appointed an interagency fire management policy review team to investigate the adequacy of national policies and their application for fire management actions in national parks and wilderness and to recommend actions to address the problems experienced during the 1988 fire season. With regard to policy, the review team recommended the following:

- Prescribed fire policies be reaffirmed and strengthened.
- Fire management plans be reviewed to assure that current policy requirements are met and expanded to include interagency planning, stronger prescriptions, and additional decision criteria. [USDA and USDI 1989.]

A moratorium was placed on all prescribed natural fire programs until the agencies had complied with the recommendations of the review team. Although NPS policies were determined to be adequate, implementation guidelines and fire management plans were found to be in need of revision.

A task force was convened to rewrite NPS-18, the fire management guideline. The guideline was completely rewritten and addressed all of the operational recommendations of the review team report (USDI National Park Service 1990). Specifically, it requires approved fire management plans, established contingency plans, quantified prescriptions, monitoring procedures, fire situation analyses, and daily certification by the line manager that resources are available to manage the fire within the prescription. In addition, the prescription must include at least one indicator of drought and at least one definition of the maximum prescribed extent of the fire.

All the existing fire management plans were reviewed by teams of fire specialists from throughout the NPS for compliance with the review team report and for adequacy of environmental documentation and public participation. Plans were sent back to the parks for revision. As of September 1992, over 100 fire management plans have been approved. Fifteen NPS areas have approved prescribed natural fire plans, nine more expect to have approved plans in 2 years, and five national parks are considering plans.

NPS fire policies have evolved in a pattern of leaps forward followed by experimentation and refinement. The decentralized nature of the agency allows it to take advantage of new philosophical ideas and translate them into policy. The experience and expertise within the NPS ensures that it will continue to play that role. ■

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Metrics, Microdisks, and *Fire Management Notes*

Keep the English Units, but Convert to Metric Too. For the past 4 years, *Fire Management Notes*, which uses the English unit system of weight and measure, has published the metric equivalent for the English unit. Metric conversions are helpful to *Fire Management Notes*' many international readers. Some of the magazine's authors regularly make those conversions on the manuscripts they submit. Thank you. Your conversions increase editing productivity. Now, a request to "unconverted" contributors—it would help a lot if you too would include the metric unit along with the English.

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Doris N. Celarier, *writer-editor, USDA Forest Service, Public Affairs Office, Washington, DC*

New Jersey's Initial Attack Strategy: Keep the Little Ones Small

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To those unfamiliar with the Garden State, the use of the words "forest fire" and "New Jersey" in the same sentence may seem like a contradiction. Many, whose only impression of the State has been via the New Jersey Turnpike or from a news story, might be skeptical about claims of significant forest resources. They would assume that the State's fires are structural and urban. However, these perceptions are inaccurate.

Although New Jersey is the most densely populated State in the Nation with over 1,000 people per square mile (386/km2), nearly 40 percent of the State is commercial forest land. Another 13 percent of the land is in parks, recreation areas, and watershed management areas. Thus 53 percent—or slightly more than half—of the State is presently forest land and open space. The high population (risk) combined with a readily available wildland fuel source (hazard) has produced a significant wildfire problem in the Garden State.

Destruction from Wildfires

Each year an average of 1,700 wildfires damage or destroy 7,000 acres (2,833 ha) of New Jersey forest land. Fires not only damage woodlands, but they also have destroyed structures and other improved property. Forest fires have become a major threat to the increasing number of homeowners who live in the State's forest environments.

Fire has been a major factor in New Jersey's environment since prehistoric times. Natural fires and burning done by Native Americans played a major role in shaping the land and creating the forests that greeted early settlers. The New Jersey Pinelands, which resulted from a 10,000- to 15,000-year fire history, is one of the most hazardous wildland fuel types in the Nation. The National Fire-Danger Rating System classifies the vegetation of the New Jersey Pinelands, with California chaparral and a number of other high-hazard fuel types, as Fuel Module B. Fuel loadings exceed 20 tons per acre (45 tons per ha) in some locales. This has been equated to having an inch (2 1/2 cm) of gasoline covering all of south and central New Jersey. Pinelands fires burn extremely hot and spread rapidly. Crown fires are fairly common—as is long-range spotting. There is a documented case of a wildfire spreading 9 miles (14 km) in 6 hours, or at a rate of 1.5 miles (2.4 km) per hour. Another fire was reported to have jumped the upper end of Barnegat Bay. In 1971, a 21,000-acre (8,499-ha) wildfire lasted—from start to finish—7 hours and 13 minutes.

A final example indicates the State's wildland-urban interface problem and potential for disaster. On the weekend of April 20-22, 1963, a series of large wildfires burned over 190,000 acres (76,893 ha) of New Jersey woodland, consuming 186 homes and 191 other buildings. Property loss was placed at $8.5 million and seven people were killed. Nearly 4 percent of the entire land area of the State was burned in one weekend! Nearly 30 years later, we know that such a disaster could occur again in the wildland-urban interface—partly because of the increase in retirement communities and residential developments.

In addition to the Pinelands, the hardwood forests of northern New Jersey also pose a significant wildfire problem. Although not as flammable as the Pinelands, the hardwood forests are located in steeper and more rugged terrain, which makes accessibility a major concern. The hills and ridges of northern New Jersey also have an increasing number of vacation and year-round residential homes.

Protection from Wildfires

The New Jersey Forest Fire Service in the Department of Environmental Protection and Energy, Division of Parks and Forestry, is the State agency responsible for protecting New Jersey forests and open space from fire. The Forest Fire Service, also known as the Bureau of Forest Fire Management, has 3.15 million acres (1.27 million ha) of both private and public land under protection.

In order to accomplish its protection goals and perform a variety of related functions, the State Forest Fire Service has a full-time force of 75 full-time employees and a large part-time force to handle the State's forest fire problems. The number of full-time State employees has dropped from a high of 92 in 1990, due to State budget cuts. The Forest Fire Service has had to do more with less—despite an increased protection area and growing wildland-interface problem. Operating efficiency and getting the most out of the dollar have become more critical as State budgets have shrunk.

Over the years, the Forest Fire Service has developed a highly effective, successful, and cost-efficient method of combating wildland fires in

New Jersey. This formula has reduced the number of acres burned and kept the cost of suppression down to one of the lowest in the Nation—despite inflation and rising operating costs.

Initial Attack Strategy

The Forest Fire Service's strategy begins with rapid early detection. The fire lookout towers have been kept open despite the fact that a number of other States and Federal agencies have abandoned theirs. Lookout towers are staffed whenever the woods are dry enough to burn. Observers can spot fires within the first 5 minutes of their start. A fire is much easier to control in its incipient stages. This is extremely important in fast-spreading fires in the Pinelands where a delay in detection of a mere 15 minutes may result in a major fire.

The State's forest fire towers are also charged with initial dispatching of equipment, notification of air bases, and helping to coordinate activities at the fire scene. Detection aircraft may be used to supplement towers during low-visibility days.

The second step in this strategy is rapid, aggressive initial attack. A combination of mechanized equipment and aerial bombing of fires has proven highly effective. It has enabled firefighters to hit fires faster and keep the average size of fires and the acreages lost low. The section forest firewarden, in most instances, forms the initial attack force and serves as the Incident Commander.

The New Jersey initial attack vehicle is the standard vehicle used by many wildland agencies in the United States, specially designed and reinforced to drive through wooded areas to get to a fire.

Initial Attack Engines

The backbone of the State Forest Fire fleet—and the vehicle used for initial attack operations—is a specially designed, reinforced engine that is capable of negotiating off-road areas to get to a fire. This use of equipment has proved highly effective in the flat-to-gently-rolling Pinelands. Forest Fire Service maintenance specialists and fire observers build all the vehicles at three regional and one State Research and Development Maintenance Facility, beginning with a Dodge[1] W350 truck chassis and utility body. A 250-gallon (946-L) tank, plumbing, and reinforcing are added to complete the job. All trucks are equipped with portable high-pressure pumps and an independent fuel supply, enabling the vehicle to continue to pump if the truck's engine stops or vapor locks during fire suppression operations.

Expanded air power and increased mechanized equipment in the late 1960's through the 1980's have reduced both the number of acres burned and the average size of fires in New Jersey.

Initial attack engines are constructed at an average cost of $31,750, which is $85,000 less than what a qualified outside vendor would charge to construct a comparable vehicle under the State bid process.

[1]The use of trade names does not constitute official endorsement of the product by the USDA Forest Service.

The elaborate system of reinforcing off-road firefighting vehicles had its origin in New Jersey. As early as the 1930's, angle iron was used to brace fenders and bumpers for off-road operation. The system of reinforcing and protection improved significantly with the advent of the Dodge Power Wagon following World War II. Additional reinforcing and roll bars were added in the 1950's and 1960's, not only to protect the vehicles but also the occupants of the cab and the rear compartment where firefighters could be stationed during pump and roll operations.

A description of the system developed for protecting New Jersey brush trucks was submitted to the Roscommon Equipment and Development Center in Roscommon, MI, in 1971. A set of seven prints were developed and have been circulated to all the Northeastern States and others on Roscommon's mailing list.

Attacking the Wildfire

The most effective strategy employed during initial attack operations is a direct flank attack using pump and roll techniques. After size-up, a section warden will proceed in a counter-clockwise direction completely around the fire. Two individuals usually constitute a crew; three is the maximum. An engine crew consists of a driver and either one or two hose operators on the back of the vehicle between the cab and the tank. Drivers proceed around the perimeter of the fire, picking their way as they go. Even though the initial attack vehicles are capable of driving over 6-inch (15-cm) pine trees, they are avoided whenever possible to reduce damage to both the vehicle and the environment. The window on the driver's side is left open so the driver knows how much heat the hose operators on the back of the vehicle are receiving. The hose operators direct a water stream out in front of the engine, knocking down the fire as the engine negotiates it and pinching off its head in the process. The engines are also set up with a small 3/4-inch (2-cm) handline that will enable a driver to operate independently. Engines are also equipped with live reels and 1 1/2-inch (4-cm) lines to increase versatility and firepower.

Whenever possible, engines are employed in tandem with the second attack vehicle reinforcing and backing up the first. This tactic greatly speeds up suppression operations. The second engine can mop up or catch what the initial vehicle missed or rekindled during its first pass. In addition, if the first vehicle runs out of water, the second one may continue with the attack.

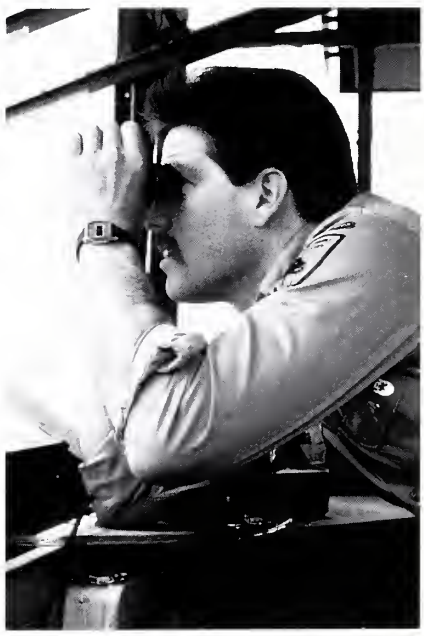
During high fire-danger periods, initial attack engines are placed on patrol in high hazard areas to provide several advantages. They not only reduce response time, but they are a deterrent to would-be arsonists, who are responsible for 50 percent of the State's forest fires. A third advantage is that task forces of two or more engines and tractor and plow units can be rapidly dispatched to fires that are reported in areas with a high fire potential.

Foam technology and wet water are added to increase efficiency and operational capabilities. All trucks have the capability of batch mixing, and foam injectors are being added to all new section trucks.

Fireline Decisionmaking

After a fire is "knocked down," a decision is made on whether to construct a fireline. This decision is made based on the fire weather, size of the fire, and turf conditions. Firelines are constructed by tractor and plow units that are available on call.

The Forest Fire Service relies primarily on John Deere 350 bulldozers, equipped with a Fesco fireplow for this task. They are capable of plowing a 5-foot (1.5-m) furrow to mineral soil and also have a blade for pushing a line. Each tractor and plow unit has a specially designed cage built around the



Fire observers such as Kevin Drake ensure that the quick initial detection of wildfires substantially reduces the initial attack time.

Table 1—*New Jersey acreage burned by decade*

Year	Acres (ha) burned	Average size of fire in acres (ha)
1960–69	311,540 (126,080)	16.87 (6.83)
1970–79	122,710 (49,661)	6.65 (2.69)
1980–89	73,748 (29,846)	4.67 (1.89)

cab to protect the operator. Unlike units in the South, New Jersey tractor and plow units do not carry water and are used only after a fire has been knocked down during initial attack operations. The State believes this policy provides safer operating conditions for the operator. Plowing fires cuts down on escapes and reduces mopup and patrol time.

Additional Specialized Equipment

The Forest Fire Service also has several pieces of specialized equipment including wide-track bulldozers for swampy areas, track vehicles for remote areas of northern New Jersey, and TD 24 dozers for the really large jobs.

Aircraft have increasingly proved their worth during forest fire suppression operations, especially during initial attack. A drop aircraft is automatically dispatched to a fire when air attack bases are operational.

The mission of the aircraft is to knock a fire down and keep it down with an initial load of water or foam until ground forces arrive. In many cases, attack aircraft can get to a fire scene faster than initial attack vehicles.

The Forest Fire Service has found the Agcat, an agricultural spray plane, to be highly efficient and cost effective in its forest fire suppression operations. The Agcat can drop a load of up to 300 gallons (1,136 L) of water or foam on a fire. The $425 per hour cost is highly competitive compared to other rates that may run into thousands of dollars. The positioning of aircraft to strategic locations around the State and subsequent movement to alternate air fields closer to the fire scene during suppression operations has reduced turn-around time and increased efficiency.

The Forest Fire Service has also recently acquired three helicopters, a Cessna 180, and a Piper PA 18 through the Federal Excess Property Program. These are being used for detection and aerial command and control operations where a "picture is worth a thousand words." Dispatching an aircraft early to a fire with developing "potential" has greatly helped managers to assess and control the fire scene and aid in command decisions.

New Jersey fuel types are classified as Fuel Model B—one of the most hazardous in the Nation.

Best Strategy for New Jersey Wildland Fire Problems—Early Detection and Rapid Initial Attack

This discussion has been directed at New Jersey's strategy and equipment for dealing with the State's wildland fire problems. It has been confined primarily to those methods used during initial attack operations and not project-size fires. New Jersey has found that the best strategy to deal with project-size fires is to keep them from becoming so in the first place! Combining rapid early detection and rapid initial attack with mechanized equipment and aircraft has proven effective in reducing the number of large and potentially destructive wildfires in New Jersey. ■

An Analysis of a Forest Fire Protection Survey for the Southern United States

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Most State forestry agencies in the Southern United States were established to meet the fire protection needs of forest lands. Today, these forest lands provide substantial economic benefits and recreational opportunities, and fire protection continues to be an important mission of State forestry agencies. In many areas of the Southern United States, however, fire protection has become a cooperative effort among Federal and State agencies, the private forest industry, and rural fire departments. Additionally, two fire compacts in the Southern United States facilitate cooperative interstate fire protection when severe fire conditions arise.

Recent economic conditions have affected fire protection operating budgets. The forest industry in some parts of the Southern United States is reducing fire prevention, detection, and suppression equipment and personnel and relying on State agencies for fire protection. The shifting of fire protection responsibilities may have contributed to a decline in fire protection costs for the forest industry from 1982 to 1988 (Dubois, Straka, Watson 1991). Most State agencies are now facing increasing fire protection responsibilities and declining operating budgets.

A survey on fire protection practices and costs in 12 Southern States (fig. 1) in 1990 provided useful data for forestry managers and planners. A total of 54 survey responses from Federal and State agencies and the forest industry provided descriptions of their forestry operations and costs. The forest industry had the most survey responses, with 39—72 percent of the total number of responses. Survey questions (table 1) were designed to elicit general information for common fire protection activities occurring in 1990, so emerging fire protection techniques and equipment may not be included. (See accompanying box for details about the survey of forest practices and costs.)

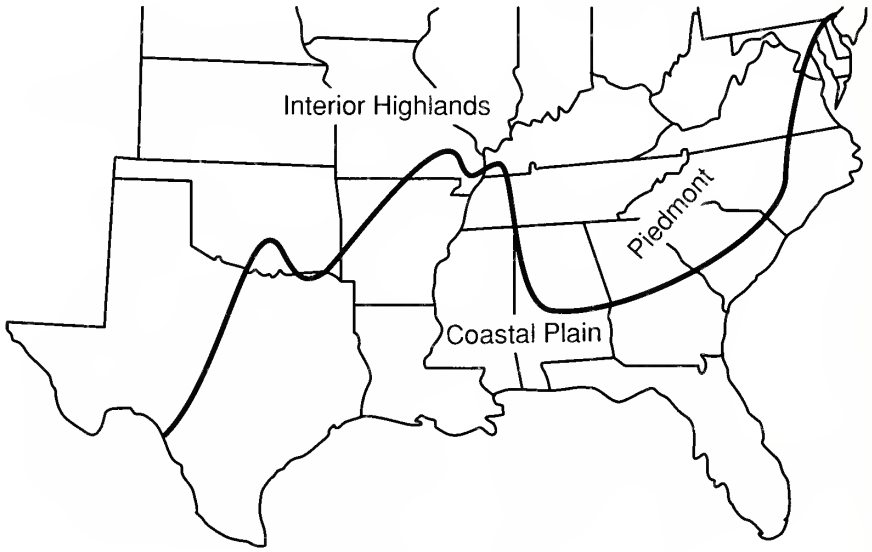

Figure 1—*The 12 States included in the survey are Oklahoma (a small part), Texas, Arkansas, Louisiana, Tennessee, Mississippi, Alabama, Georgia, Virginia, North Carolina, South Carolina, and Florida. Respondents use this map to identify the physiographic characteristics associated with their forest operations.*

Forest Land Fire Protection

Type of Organization and Geography. Figure 2 summarizes information from the 54 survey respondents about the acres of forest land protected, according to type of organization. State agencies, with five survey responses, accounted for 56 million acres (23 million ha) or 69 percent of the reported acreage. This State acreage probably includes forest lands also protected by forest industry and possibly that of the Federal agencies. The Coastal Plain region accounted for 72 million acres (29 million ha)—89 percent of the total area reported.

Detection Systems. Fire detection systems in the Southern United States have shifted from ground-based tower systems to air-based detection systems. Figure 3 shows fire detection systems used by type of organization and categorized as air, tower, air and tower, and other. Air-based fire detection systems accounted for 26 million acres (11 million ha) or 32 percent of the total. Tower-based fire detection systems were reported only by the forest industry, which probably relied on fire detection provided by

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Table 1—*Questions included in the general fire protection survey*

1. Number of acres protected_____

2. What is the primary type of equipment used for fire suppression?

_____

Examples: John Deere 350 with rear-mounted plow.
Caterpillar D3 with rear-mounted plow.

3. What is the primary method of fire detection? (Check one)
Aerial____ Fire tower____ Ground____
Combination (please specify)_____

4. Average cost per acre for area protected as:
Direct labor_____
Equipment_____
Supervision_____
Overhead_____

Total cost per acre_____

State-owned and -operated fire towers. Federal agencies relied heavily on air-based detection systems with such systems accounting for 98 percent of their acreage reported. State agencies relied on various combinations of detection systems, with 79 percent of the acreage under the air and tower and other categories. The "other" category includes a variety of systems, including ground detection, combinations of air, tower, and ground, and reliance on State agencies for fire detection.

Crawler Tractor Size. Fire suppression systems in the Southern United States were based largely on ground-based equipment such as crawler tractors for constructing fire lines. Information from the survey was categorized by the size of the crawler tractor (fig. 4). "Small" tractors are

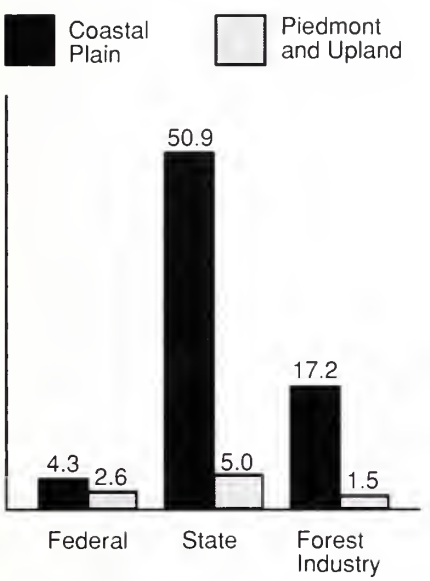

Figure 2—*Number of acres (in millions) protected by type of geography and organization.*

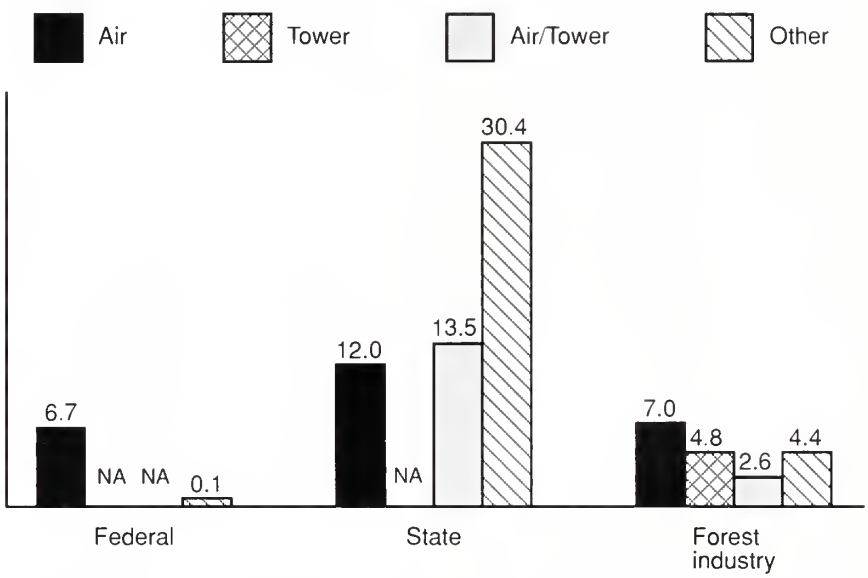

Figure 3—*Number of acres (in millions) protected by type of organization and fire detection system. "Other" includes ground detection; combinations of air, tower, and ground; and reliance on State agencies. (NA means information not available.)*

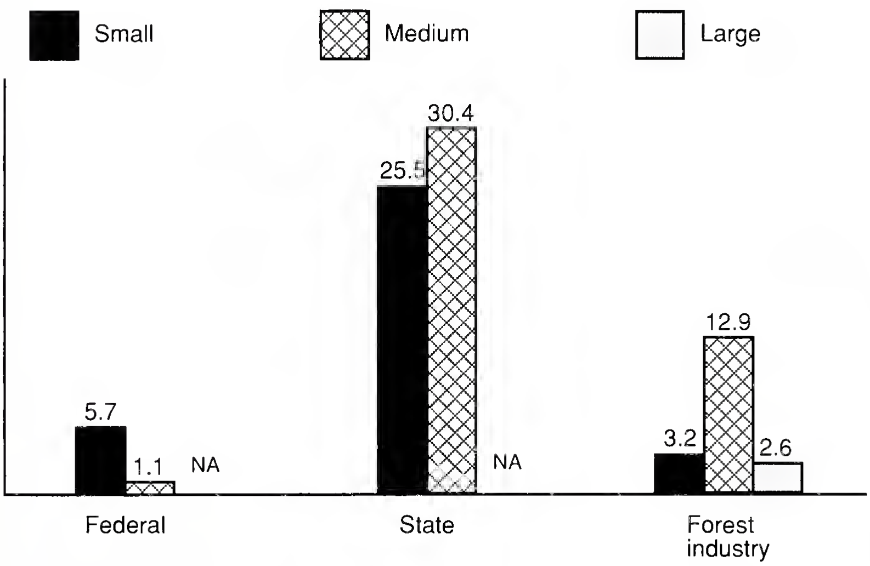

Figure 4—*Number of acres (in millions) protected by type of organization and size of crawler tractor. "Small" tractors are smaller than a John Deere 450 or Caterpillar D3, "medium" are John Deere 450 and Caterpillar D3 or D4 (or equivalent), and "large" are those larger than a Caterpillar D4. (NA means information not available.)*

smaller than a John Deere 450 or Caterpillar D3,[1] "medium" are John Deere 450 and Caterpillar D3 or D4 (and equivalent), and "large" are those crawler tractors larger than a Caterpillar D4. Small equipment protected 42 percent and medium equipment protected 55 percent of the total acreage. Figure 4 shows there was a marked difference in size of equipment used by type of organization. State agencies used 46 percent small tractors compared with 54 percent medium. The forest industry, however, relied more heavily on the medium-sized equipment—69 percent as compared with 17 percent for the small equipment.

[1] The use of trade names does not constitute official endorsement by the USDA Forest Service, Mississippi State University, and Clemson University.

In times of dwindling operating budgets, labor costs and how they are controlled become ever more important to managers and the future cost of fire protection.

Fire Protection Costs

Survey respondents provided information about the costs of fire protection, detection, and suppression systems, which are summarized on a per acre basis in figure 5. The average cost per acre is weighted by the area of forest land protected.

Type of Organization and Region. Overall average fire protection costs for 1990 were $0.64 per acre ($1.58/ha) in 1990. Fire protec-

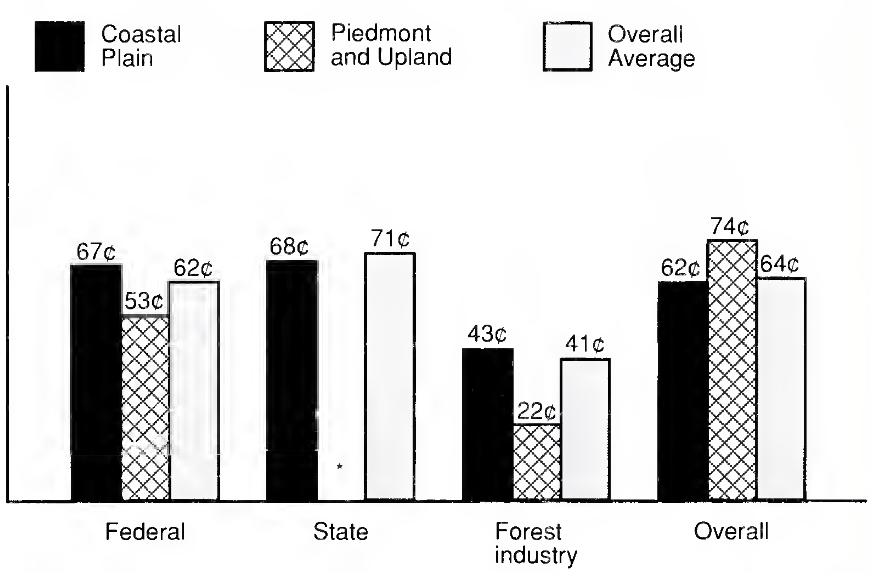

Figure 5—*Weighted average cost (cents per acre) of general fire protection by type of organization and geography. (The asterisk (*) indicates an insufficient number of responses to show cost information.)*

tion costs in the Piedmont and other upland regions were slightly higher than the Coastal Plain—$0.74 compared with $0.62 per acre ($1.83/ha compared with $1.53/ha). The overall average cost of fire protection varied by type of organization. State agencies had the highest at $0.71, followed by Federal agencies at $0.62, and the forest industry at $0.41 per acre ($1.75, $1.53, and $1.01/ha). Differences in fire protection costs may be attributed to missions of each organization. State agencies have a more defined mission of fire protection compared with Federal agencies and forest industries. Consequently, their operating budgets reflect a greater emphasis on fire protection. Additionally, forest industries rely more heavily on State agencies for protection.

Detection Systems. As fire detection has shifted from tower-based to air-based systems, dollars have been saved. The overall average cost of fire protection for those using air-based detection systems was lower than those for tower-based systems—$0.34 as compared with $0.50 per acre ($0.84/ha compared with $1.23/ha) (fig. 6). Within the forest industry, costs for air-tower detection systems were just slightly higher than those that use air detection only—$0.27 compared with $0.25 per acre ($0.67/ha compared with $0.62/ha)—but air-based system costs were substantially lower than the $0.50 per acre ($1.23/ha) for tower systems.

Crawler Tractor Size. Fire protection costs decline with increasing size of crawler tractor (fig. 7). For those survey respondents using a small tractor, overall fire protection costs per

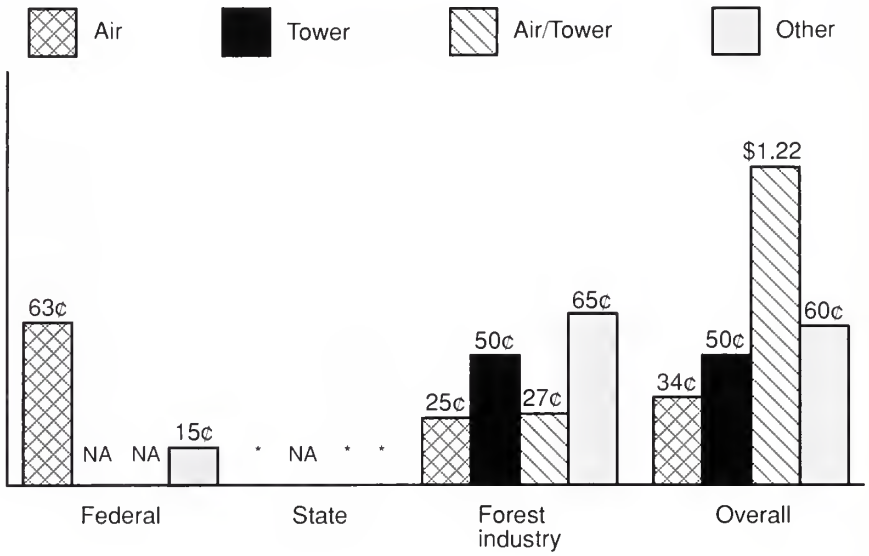

Figure 6—*Weighted average cost (dollars and cents per acre) of general fire protection by type of organization and fire detection system. "Other" includes ground detection; combinations of air, tower, and ground; and reliance on State agencies. (The asterisk (*) indicates an insufficient number of responses to show cost information; NA means information not available.)*

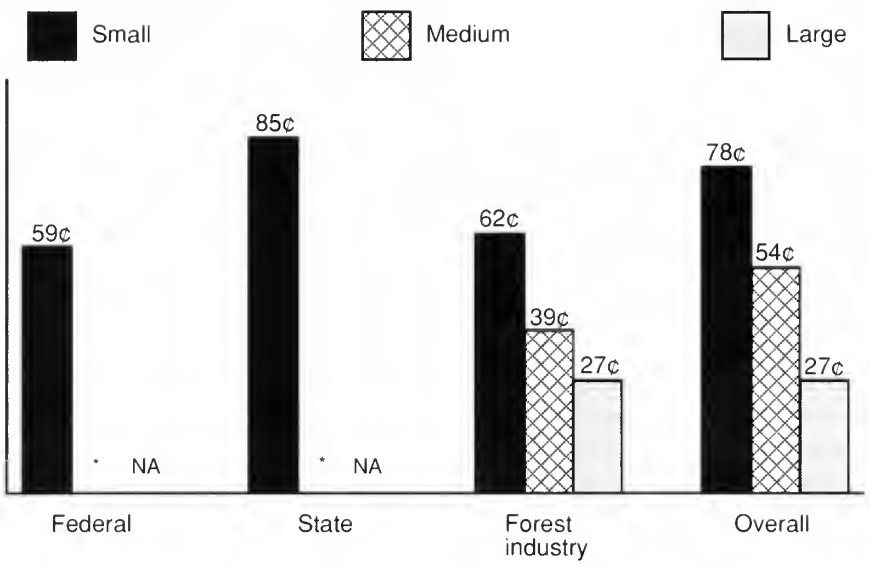

Figure 7—*Weighted average cost (cents per acre) of general fire protection by type of organization and crawler tractor size. "Small" tractors are smaller than a John Deere 450 or Caterpillar D3, "medium" are John Deere 450 and Caterpillar D3 or D4 (and equivalent), and "large" are those larger than a Caterpillar D4. (The asterisk (*) indicates an insufficient number of responses to show cost information; NA means information not available.)*

acre averaged $0.78 ($1.93/ha). This compares with the $0.54 and $0.27 cost per acre ($1.33/ha and $0.67/ha) for medium and large crawler tractors, respectively. Several factors may influence these costs:

- Larger equipment is more efficient in constructing fireline.
- Smaller tractors may be used only for fire suppression, thus fire protection bears all costs.
- Larger equipment may be used for several forest operations, so fire protection costs are only a portion of the equipment cost.

Cost Components. Figure 8 disaggregates fire protection costs into labor, equipment, supervision, and overhead components by type of organization. Differences in component costs can be attributed to organizational management objectives. Federal agencies and forest industries have a more diverse set of management objectives compared with State forest agencies. State forest agencies have a relatively heavier emphasis on fire protection. Consequently, State agencies' labor and supervision costs for fire protection should be relatively higher than those for Federal agencies and the private forest industry. Labor and supervision costs accounted for 79 percent of the total fire protection costs for State agencies. This compares with 44 and 47 percent for Federal agencies and the forest industry, respectively.

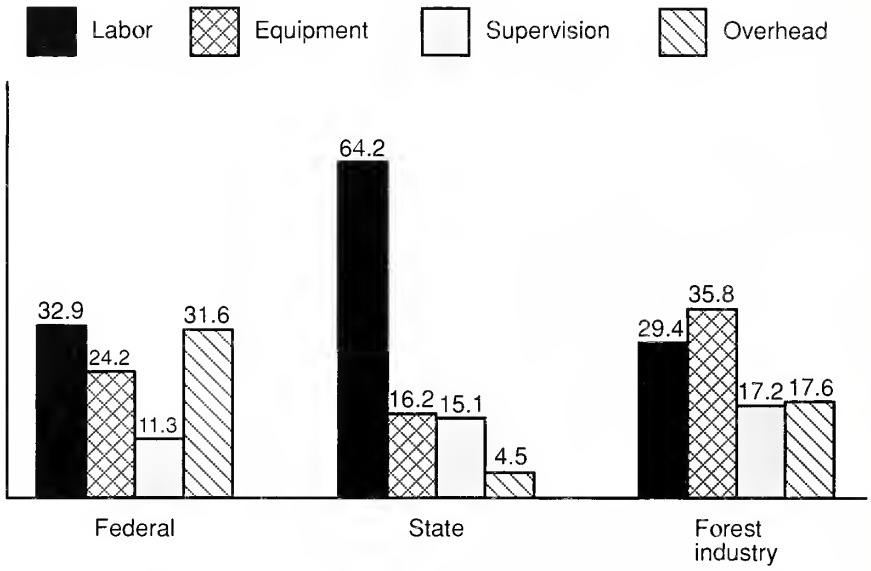

Figure 8—Cost components (percent) for general fire protection by type of organization.

Fire Protection Trends, Missions, and Their Ties to Cost

State agencies have the major responsibility for forest land fire protection in the Southern United

Survey of Forest Practices in the South

Information contained in this article was gathered from an ongoing survey that provides detailed forest practice and cost information on forest practice activities:

- Site preparation
- Tree planting
- Controlled burning
- Chemical treatments
- Fertilizer treatments
- General fire protection
- Timber cruising
- Timber marking
- Precommercial thinning

The survey has been continuous since 1952—it is the oldest ongoing survey on forest practices. Those surveyed include forestry consultants and forestry managers associated with Federal and State agencies as well as the forest industry in the Southern United States. The 1990 survey resulted in 147 responses with 47 percent from the forest industry, 29 percent from forestry consultants, and 24 percent from public agencies (Dubois, Watson, Straka, Belli 1991). Personnel from the Department of Forestry, Mississippi State University, have conducted the survey since the late 1960's, and current surveys are published every 2 years in the *Forest Farmer*. For more information about the survey, contact Mark Dubois, (601) 325-2946.

States. The forest industry appears to have shifted some of its fire protection activities to State agencies. At the same time, fire detection systems have shifted from ground-based tower systems to air-based detection systems. Crawler tractors continue to play a major role in the South's fire suppression systems.

The overall cost of fire protection averaged $0.64 per acre ($1.58/ha) in 1990. The missions of fire protection organizations affected the average costs: State agencies were highest at $0.71 per acre ($1.75/ha), followed by Federal agencies at $0.62 per acre ($1.53/ha), and forest industry at $0.41 per acre ($1.01/ha). When fire detection shifted from tower-based to air-based systems, costs were reduced from $0.50 to $0.34 per acre ($1.23/ha to $0.84/ ha). Labor costs comprised a substantial component of total fire protection costs regardless of organization type. In times of dwindling operating budgets, labor costs and how they are controlled become ever more important to managers and the future cost of fire protection. ■

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A New Ordering System for Cooperative Forest Fire Prevention (Smokey Bear) Materials

In November 1991, Fire and Aviation Management Assistant Director Mary Jo Lavin appointed the Cooperative Forest Fire Prevention Ordering System Task Force to devise a new system for ordering Smokey Bear fire prevention materials. The task force, chaired by Fire Planning Program Analyst Jerilyn Levi, recommended that we add the ordering system to the National Fire Cache System. State and Private Forestry Deputy Chief Allan J. West approved the task force recommendation in June 1992.

The new system will allow year-round ordering of prevention materials for Federal and State agency users anywhere in the United States. The Forest Service anticipates improved cost efficiency and turnaround time for orders.

By January 1993, materials will be available for order from the Northeast Interagency Fire Cache in Grand Rapids, MN. Using its warehouse space, computerized inventory systems, and shipping and receiving capabilities, the cache will store Smokey Bear items, take orders, and make shipments. Minnesota Shared Services of the Superior National Forest will purchase items from contractors and vendors to keep the cache stocked.

The selection of items to be offered through the catalog and the production of the catalog will remain in the Washington Office.

Look for your 1993 Cooperative Forest Fire Prevention catalog and ordering instructions to arrive in November 1992. ■

Tammy J. West, *program specialist, USDA Forest Service, Fire and Aviation Management, Cooperative Forest Fire Prevention Program, Washington, DC*

Texas Forest Service Calling Dozer-One

Bill Terry

Head, Training Section, Texas Forest Service, Lufkin, TX

Not many city and county fire departments in Texas own a bulldozer (a crawler tractor with a blade attached, commonly referred to as a dozer). For years, the State used dozer plow units for fireline construction in East Texas, but there was no formal agreement between a volunteer fire department and the Texas Forest Service (TFS). "Dozer-One" has changed all that.

What is Dozer-One?

Since March 1, 1991, Dozer-One has been a joint program between the TFS and the Bastrop Fire Department to improve fire protection for local landowners. (Bastrop, county seat of Bastrop County, is in eastern Texas, slightly southeast of Austin, the Texas State capital.) The TFS and the Bastrop Fire Department entered into an agreement, or contract, to "enhance, improve, and formalize the Texas Forest Service-Fire Department organization and operation on forested, nonforested, and rural lands in Bastrop and surrounding counties." The agreement spells out how the system will work:

- When the need arises, the TFS requests help from the Bastrop Fire Department.
- The TFS furnishes all the equipment including the tractor, truck, radio, clothing, and training. They also pay a small hourly wage to specially trained volunteer firefighters.
- In return, the Bastrop Fire Department furnishes at least two trained and experienced firefighters to be on standby during dry, high-danger periods. The program helps the county by adding another fire unit in the form of Dozer-One. It helps the TFS by supplying additional firefighters to do the work.

Why Was It Needed?

Jim Blott, area forester with the TFS, has seen the number of their firefighters reduced almost 30 percent since 1978. While the TFS firefighting staff was shrinking, Bastrop and counties like it were experiencing a phenomenal growth in population. Newcomers were locating their homes well off roads that are not accessible with conventional fire equipment. Also, because much of Bastrop County is forested, special equipment is often required to build firelines and deal with the rough terrain. According to Mike Fisher, chief of the Bastrop Fire Department, "For two or three seasons, we had so many fires, the Forest Service resource was not adequate. We had a county dozer for about 10 years, but that alone didn't seem to be enough." Statewide, there are many counties and communities that have the same problems.

In May 1984, a fire swept through the Bastrop County "Lost Pines" region, an ecologically distinct forest region located outside of the traditional commercial forest region of East Texas where agency firefighters are concentrated. The Lost Pines area is a difficult area for the TFS to protect. "We have an extremely isolated condition in Bastrop County," forester Blott remarked. "With the closest units located in Montgomery and Walker Counties, our response time can be slow." During the 4-day

Student dozer operators unload plow units to begin the first training exercise. This is the first formally organized wildland firefighting unit in Texas—outside of the Texas or USDA Forest Service. Photo courtesy of Bill Terry, Texas Forest Service.

siege, thousands of acres were burned. Remnants of the fire can still be seen near Highway 71 between Bastrop and Smithville.

Although most residents consider the "Lost Pines" region a special case because of its ecology, there is over $109 billion worth of improved property in rural Texas. Much of this is either range, forest, crops, or structures. The 1984 fire was so large that the TFS overhead personnel, fire department personnel, and National Guard helicopters were combined to form a huge firefighting force. A command post was established and the Incident Command System was used.

It was this fire that helped convince the TFS that an alternative had to be developed to protect, in the future, the resources, people, and property of Bastrop and the surrounding area. With tax shortfalls predicted for the TFS for at least the next 2 years, the situation would only get worse.

Advantages of Dozer-One

"Dozer-One allows us to beef up our response time because we can work with a supplemental pool of firefighters until our units can move in from the other districts," said Blott.

Chief Fisher feels that Dozer-One has helped out tremendously on fires in the county. "One of the spin-offs of this program," he said, "is that it is a great opportunity for some of our firefighters. It gives them more incentive and something else to be interested in." He added, "We used Dozer-One as a training or skill development tool where the firefighters had to meet certain structural firefighting criteria before they could participate in the Dozer-One program. It has moved our total program along."

Dozer-One is a joint program between the Texas Forest Service and the Bastrop Fire Department to improve fire protection for local landowners. The Texas Forest Service furnishes all the equipment (the tractor, truck, radio, clothing) and training, and the Bastrop Fire Department, at least two trained and experienced firefighters to be on standby during dry, high-danger periods.

He added that there was still another benefit, "Having the dozer and a trained crew has almost eliminated the need for the little four-wheel drive, off-road brush truck and has saved a great deal of wear on other vehicles."

Ronnie Duncan, a Bastrop firefighter participating in the Dozer-One program, said, "Using this dozer is better than getting out there with handtools and dragging hose through the woods. We let the equipment do the work."

Vicki Graffinberg, a firefighter from the Heart of the Pines Fire Department located near Bastrop, says, "If someone is at a fire and they need someone to operate the dozer, I want to be able to do it."

Outlook for Future Agreements

There is a possibility of a future agreement between Bastrop County and the Bastrop Fire Department. While this is somewhat different from the agreement between the TFS and Bastrop Fire Department, the county will agree to furnish the dozer and the county fire departments will furnish the people. This may be a good fire protection option for other counties across the country.

"We have asked the county for some help," says Fisher. "We have first of all asked for some funding. Then we have asked for some `in kind' services such as permitting county employees to become firefighters for daytime help." He concludes, "The commissioners have agreed they can divert some of their dozers, loaders, and even water trucks to help on the bigger fires. Even if we had a bunch of little wild fires, they could keep us from being spread too thin."

In the past year, Travis County, the location of the State's capital, has developed a similar agreement where the county supplies up to four pieces of equipment for line construction to assist the fire departments on large wildfires. The TFS has also trained county employees in line construction to form a heavy-equipment strike team. The result is a better prepared firefighting task force to protect lives and property in the rural and interface areas.

The Results: Economy, Pride, and Better Protection

With more government programs coming under the "gun," doing more with less is probably the way of the future. Programs like Dozer-One will not only help reduce the tax burdens, but also will produce a pride in the community and a pride in service that tax dollars simply cannot buy. ■

Evaluation of the Hanover™ Firefighter in the Swamps of Southeast Georgia

Alan Dozier and Bill Fyfe

Associate chief, Forest Protection Department, Georgia Forestry Commission, Macon, GA, and president, G.R. Manufacturing, Inc., Trussville, AL

In October 1989, the first Hanover™ Firefighter[1] was displayed at the National Association of State Foresters' meeting in San Antonio, TX. This articulated, four-wheel drive machine is similar in configuration to a timber forwarder. It was manufactured by the former Robbins Manufacturing, Inc., in Birmingham, AL. John Mixon, Georgia's State Forester, immediately recognized that the high flotation and large water capacity of this unit could have proven useful in combating wildfires in the swamps of southeast Georgia. He made arrangements through the Forest Protection Department of the Georgia Forestry Commission (GFC) to evaluate this machine in Georgia.

An initial agreement between the GFC and Robbins Manufacturing, Inc., was made that included the following:

- Robbins would provide the basic machine with a 1,200-gallon (4,542 L) tank but with no pumping or spraying equipment.
- The GFC would select and furnish pumping and spraying equipment and provide the expertise and staff to install the equipment. GFC would also conduct trials of the machine and demonstrate it to interested parties.
- The GFC would have unlimited use of the machine through the spring fire season. After that, Robbins would be able to use and demonstrate the fully equipped machine to interested parties outside Georgia.

[1]The use of trade names does not constitute official endorsement of the product by the USDA Forest Service.

Rear frame extension and housing for pump, hose manifold and booster reel, and hose.

In November, the machine was delivered to the GFC, headquartered in Macon. In addition to the large tank, it was equipped with an 89 horsepower Ford diesel engine and 66 x 43.00-25 tires. It was obvious that it could easily be built to a specific configuration by varying wheelbase, tire size, tank size, and pump or spraying equipment.

The GFC's Rural Fire Defense specialists and fabrication shop went to work to equip the Hanover with a 25 FR Hale pump, a foam injection system, a multiport hose manifold, 1-inch (2 1/2-cm) booster hose and reel, 1 1/2-inch (4-cm) deck gun monitor, two downswept 12/24 gallon-(45/91-L) per-minute (gpm) nozzles, a deck gun operator's station, and brush protection for the spray equipment. In January, the GFC made the first trial run and completed final adjustments.

The Modified Unit on Trial in Swamps

In February, the newly equipped unit was delivered to the Waycross District in southeast Georgia. This area has a high fire-incident rate combined with typical southern coastal fuel types and terrain. A pine plantation with a palmetto-gallberry understory covers one-third of the district's land area. The remaining forested area consists of natural pine, hardwood bays, cypress ponds, and peat swamps. Fires occurring in the bays and swamps in the dry periods pose special problems because poor underfooting prevents the use of tractor plow units in these areas. The large fire acreages involved, combined with dense vegetation and poor underfooting, make mopup procedures difficult at best. The new unit provided the option to use direct attack as

well as effective mopup tactics on this type of fire.

The Dixon State Forest was the site of the first trial for the unit. It drafted 1,200 gallons (4,542 L) of water from a canal in 5.7 minutes. The machine was first operated in a typical pine stand to familiarize its operators with its maneuverability and water-handling capability. The sandy forest floor underneath the palmetto-gallberry understory was left undisturbed except for the cleats of the 66 x 43.00-25 forestry tires penetrating the soil.

The machine was next driven to a gum-cypress swamp that had burned the previous year. It carried the load of water through muck that a tractor plow unit could not negotiate. Water quickly filled the 2-foot (60-cm) deep tracks left by the large flotation tires.

Another trial was arranged for late February near Waycross—this time as a demonstration to GFC fire personnel from the coastal districts. Again the machine negotiated the previously off-limits terrain as the two downswept nozzles laid down lines of foam. Larry Watson, Ware County forest ranger, remarked, "This thing will go any place that we have any business fighting a fire!" Firefighters took turns operating the machine with one driving and another operating the 1 1/2-inch (4-cm) turret-type nozzle from the operator's platform. The machine demonstrated its fire-quenching ability by delivering a direct stream of foam with a reach in excess of 60 feet (18 m). The bubble cup nozzle could be adjusted to produce a wide blanket of foam as well as a straight stream. The 12/24 gpm downswept nozzles on each side not only laid lines of foam, but they also provided fire protection for the tires. The Hanover™'s ability to pump and roll through forested terrain impressed the GFC tractor plow operators.

Those who attended the Okefenokee demonstration were impressed by the machine's ability to draft and transport water at speeds up to 14 miles per hour on the perimeter road and for some distance into the swamp's edge.

Late in February, the unit was field tested in Georgia's Roundabout Swamp near Pearson, GA. This 3,000-acre (1,214-ha) swamp with an average peat depth of 8 feet (2.4 m) has been the site of several project fires in recent years. Although the most recent Roundabout fire consumed only 52 acres (21 ha), firefighters spent more than 4 weeks laying hose and pumping an estimated 2 million gallons (over 7 1/2 million L) of water from existing canals to drench the peat fire.

A main goal of this particular field test was to maneuver the machine into increasingly poor underfooting until the machine was bogged down and unable to move. The machine maneuvered well through any area with enough vegetation and root mass to give it traction. A prairie-type area proved to be its nemesis, however, because the lack of vegetation caused the machine to sink into the mud.

The unit was next demonstrated to the U.S. Department of the Interior Fish and Wildlife Service and several USDA Forest Service representatives using the Okefenokee National Refuge as a demonstration site. Several fires in this 400,000-acre (161,880-ha) wilderness swamp had recently

Deck gun monitor and booster hose cool hotspots at peat fire at Hinesville, GA.

Hanover™ demonstration at Okefenokee Swamp Refuge

threatened structures, campgrounds, and private timber. The unit negotiated the edge of the Okefenokee well. Those who attended this demonstration were impressed by the machine's ability to draft and transport water at speeds up to 14 miles per hour (23 kph) on the perimeter road and for some distance into the swamp's edge. Participants were also impressed with how quickly and easily they became comfortable operating this machine.

The Unit's Trial by Fire

The unit was next deployed to a 15-acre (6-ha) peat fire in Hinesville, GA. Initial attack was complete, and this fire was in the mopup stage when the machine arrived. Tractor plow units had been used to contain the fire, but many hotspots remained inside the perimeter. The normal mode of operation on this type of fire has been either to let it burn until sufficient rainfall occurs or to lay hose into the hotspots to put them out. Because this fire was located in a wildland-urban interface, the decision was made to drench the hotspots with water.

Using the mobility and rapid response of the unit, the crew was able to move instantly to areas of most urgent need. A crew of three operated the unit: a driver, deck gun operator, and spotter on the ground, who also used the booster hose. Utilizing the large tank capacity, the crew would typically work hotspots for about 40 minutes and then spend 10 minutes going to and from the city hydrant for refilling.

This fire provided an opportunity for the machine to work side by side with a hose lay operation. Approximately 2,000 feet (609 m) of 2 1/2 inch- (6-cm), 1 1/2 inch- (4-cm), and 1 inch- (2.5-cm) hose had been laid out and was in use when the unit arrived. The presence of the hose on the ground did not restrict the unit's mobility because tires (which had a low ground pressure) could drive over the hose without causing any apparent damage.

The Unit in North Carolina

After the evaluation in southeast Georgia, the machine went on trial in the mountain region of western North Carolina. Although the evaluation was not as extensive as the one in Georgia, the machine did handle the water load safely on the steep slopes, indicating its potential to work in this environment.

Advantages of the Unit

Comparing use of this unit to a conventional hose-laying, mopup operation, the following points are worth noting:

- Less equipment is required. The one Hanover™ can perform in place of a stationary pumper, hose lays, and miscellaneous support equipment.
- Far fewer firefighters are required. A crew of three operated two nozzles (a ratio of 1.5:1). By contrast, the hose crews required four firefighters to operate one nozzle (a ratio of 4:1).
- Response time to flareups is reduced. The Hanover™ can quickly respond to hotspots. There is no time spent picking-up and re-laying hose. The machine simply drives to the hotspot, knocks it down, and then moves on to the next problem.

- Demobilization time is reduced. Once the machine is loaded on a lowboy trailer, it is ready to go on to the next fire or return to base. There is no hose to be cleaned, dried, and stored.
- The Hanover™ provides an extra level of security in the wildland-urban interface because it can maneuver, uninhibited, from yard to yard to help protect houses.

Evaluation and Future Options

The GFC had envisioned this unit as an ideal machine for mopup operations in low ground-pressure conditions. Its use on the Hinesville fire confirmed that it can efficiently deliver large volumes of water, foam, or both in a timely manner. This performance encourages the GFC to evaluate its use in initial attack at the first opportunity. For more information about the modification of the unit or its use, please contact Alan Dozier of the GFC at (912) 751-3492 or Bill Fyfe at G.R. Manufacturing, Inc., (205) 655-8001. ■

Ted Putnam Honored for Fire Safety Accomplishments

USDA Forest Service equipment specialist at the Missoula Technology and Development Center (MTDC), Dr. Stuart E. "Ted" Putnam was recently honored with two national awards for his work in designing and testing personal protective equipment for wildland firefighters. This past spring Putnam was awarded the Government Employees Insurance Company (GEICO) Public Service Award in Fire Prevention and Safety, and this summer, the U.S. Department of Agriculture (USDA) Distinguished Service Award for Safety and Health. Putnam, who has been with MTDC since 1976, pioneered the development of the fire shelter, an aluminum pup tent that has saved the lives of many wildland firefighters.

The GEICO Public Service Awards are presented annually to four civilian career Federal employees and one retired Federal employee for outstanding achievements in public service. The USDA Honor Awards are presented to USDA employees for outstanding accomplishments.

From right to left are L.A. (Mic) Amicarella, Staff Director, Fire Aviation and Management, Forest Service; awardee Dr. Putnam, equipment specialist, Missoula Technology and Development Center, Forest Service; Mrs. Putnam; and Bob Joens, branch chief, Fire Equipment and Chemicals, Fire Aviation and Management, Forest Service.

Under Putnam's leadership at the MTDC, new technology has been used to develop, refine, and improve flame-resistant clothing, protective leather gloves, and most significantly, the fire shelter, for wildland firefighters. The shelter has been credited with saving the lives of more than 200 entrapped wildland firefighters since 1977. Putnam, who has been a firefighter and a smokejumper, has combined both scientific expertise and practical field experience in the development of protective equipment, which earned him an international reputation as an expert in this field.

Putnam not only designs protective gear but also is active in field reviews and evaluations of equipment performance and in the development of teaching materials for wildland firefighters. He also serves on the National Fire Protection Association's Wildland Fire Fighting Protective Clothing Subcommittee, a body that is developing standards that will affect more than 350,000 firefighters. ■

Brendan Tu and Enid Hodes, *respectively, graduate student at Colorado State University, USDA Forest Service, Rocky Mountain Region, Air, Aviation, and Fire Management, Cooperative Education Program, Lakewood, CO, and editor, USDA Forest Service, Public Affairs Office.*

Rx for Flexibility During Budget Unrest: Contract for an Initial Action Engine

Mark Beighley

Fire management officer, USDA Forest Service, Deschutes National Forest, Bend Ranger District, Bend, OR

In the fall of 1990, the Pacific Northwest Region of the USDA Forest Service projected an overall decrease in its budget for the next 2 years. In response, management directed that the fixed organization be reduced whenever possible—without a reduction in force. At that time, the level of financing for the Bend Ranger District fire suppression organization allowed the funding of four initial action engine modules: three from Forest Fire Fighting Protection (FFFP) funding and one from Brush Disposal (BD) deposits from timber sales (to provide interim protection in harvested areas until logging slash is treated to acceptable levels). When the crew leader position on one of the engines on the Bend District became vacant, the chance was given to explore alternative methods of providing that engine module without any adverse effects on permanent seasonal personnel.

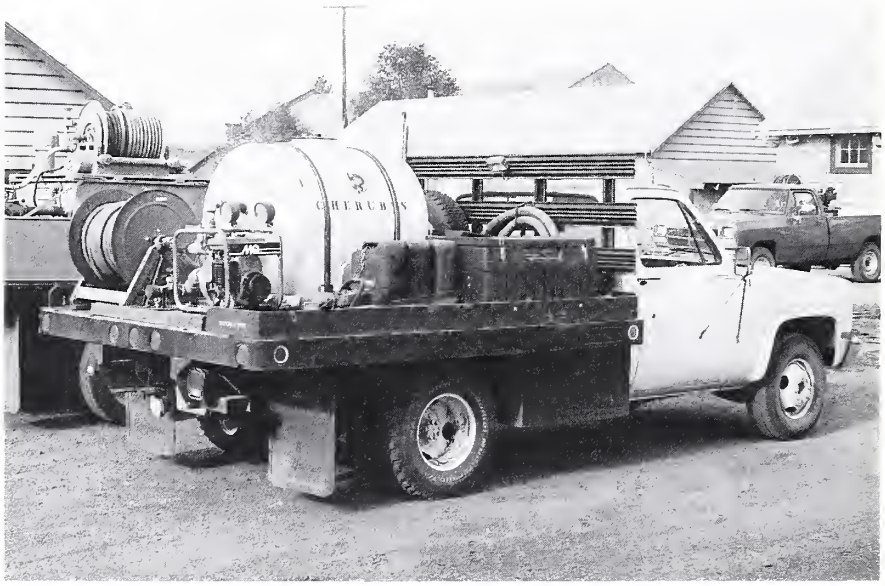
The Contracting Experience and the Decisionmaking Process

Contracting for firefighters for use on Forest Service engines had been successful on the Winema National Forest several years earlier during a similar period of workforce reduction. The hiring of firefighting operators and equipment had been a common practice of the Forest Service on Emergency Equipment Rental Agreements. However, this hiring had been based on rates fixed by the Government as opposed to rates bid by contractors. A Northwest Interagency Committee, representing the Forest Service, U.S. Department of the Interior Bureau of Land Management, Oregon Department of Forestry, and Washington Department of Natural Resources, decided to try a new idea. Why not contract for call-when-needed (CWN) engines and water tenders? Contractors would bid competitively on rental rates when providing equipment and trained personnel for firefighting, possibly reducing the cost of some items and generating rates common to all user agencies.

It seemed reasonable to take the same idea one step further and attempt to contract for a complete initial action (IA) engine module, truck, and trained firefighters to be on duty for a designated time during fire season. The bids could then be made based on a guaranteed amount of work, something not possible with the Northwest Interagency contract. Initial reactions of local Forest Service fire personnel can be described as "apprehensive," but it was an alternative to the traditional approach of hiring Forest Service employees to staff a Forest Service engine. The Deschutes Forest Supervisor and the Bend District Ranger encouraged the concept, and the effort was given the green light.

Following are the concerns that surfaced:

- The cost of the contract would be higher compared to traditional staffing of Forest Service engines with hired employees.
- The quality of the equipment and the skill and experience of the firefighters would not be as high as usual.
- There would not be as much management flexibility for controlling duty hours and work schedules.
- There might be an increased frequency of arson fires for financial gain.



Cherub's Fire Control (contractor) Type 6 engine.

- There will be additional costs of contract development and administration.

Of course, others pointed out that if this effort succeeded, there would be some obvious benefits:

- There would be a reduction in the Government employee workforce.
- The contractor would handle the hiring, firing, timekeeping, training, and other personnel-related workload.
- Accidents and injury reporting and claims would be the responsibility of the contractor.

Contract Specifications

In order to maintain some level of standardization, the Bend District IA engine contract used the Northwest Interagency contract specifications for a Type 6 engine, equipment, and personnel training. The Government would provide equipment, such as hose and fittings, that would normally be left on fires for more than the initial operational period. The contractor could then immediately resupply, from any Government cache, items they were directed to leave on a fire. Also, the engine was to be used on fires only when a Forest Service officer was assigned as the Incident Commander or when assigned to a Forest Service strike team. The contract inspection duties could then be assumed by the Incident Commander or strike team leader, and the assignments given to the engine contractually became a work order. This facilitated equipment accountability and contract administration needs while the engine was temporarily assigned away from its normal operating area.

Typical Forest Service Type 6 engine.

Contract Flexibility

The contract was developed to provide a minimum of 77 days' coverage within the mandatory contract period—from June 24, 1991, though September 28, 1991. This coverage included the engine, an operator, and a firefighter. When the fire danger was at a "low" level, it would be at the discretion of the fire manager whether the engine would be on- or off-duty on any given day. When the fire danger rose to a "moderate" level, two staff members and the engine were required to be on duty from 0930 to 1800. After August 1, on days when the fire danger reached a "high" or "extreme" level, a second firefighter was required (producing a total staff of three). The contract estimated that these situations would occur a minimum of 25 days during the mandatory contract period. At the "extreme" fire-danger level, the engine was usually kept on duty an additional hour, until 1900, but this was not originally written in as a contract specification. This cost was accounted for in the bid item for 300 overtime hours. A moderate amount of flexibility was written into the contract so that staffing could be responsive to fluctuations in fire-danger levels, providing efficient utilization of the resource.

Estimating Contract Costs

The cost estimates worked up for the contract were based on local experience, using comparable Forest Service equipment rates. Table 1 displays the contract cost estimated by the Forest Service. The 300 overtime

hours (hours worked outside the 0930 to 1800 period) were included in the contract as an estimate. Therefore, the Forest Service was not obligated to pay the entire amount unless staff actually worked as ordered.

A total of 11 contractors placed bids. Three of the 11 were nonresponsive to the bid and could not be considered. The remaining eight bids were as follows: $41,610.00, $42,694.19, $53,240.60, $58,548.92, $59,456.69, $62,766.75, $64,759.95 and $81,656.00.

Awarding the Bid

The eight bids were far greater than the Government-estimated cost of the contract (table 1). Since overtime pay (item 1.D) is only an estimate and is generally accrued while on fire assignments, this amount would be paid mostly out of nondistrict budgeted emergency funds (FFFF).

In 1991, the Bend Ranger District, Deschutes National Forest, contracted for a complete initial action engine module, truck, and trained firefighters to be on duty for a designated time during fire season. The success of that project has encouraged them to continue with another improved contract for the 1992 fire season.

Excluding the overtime estimate, the potential financial burden on the district fire protection budget could be roughly estimated at $25,860, much closer to the contract estimate of $21,458. Additionally, some of the cost of a Type 6 engine with engine boss and crew member, one additional crew member, and mileage (items 1.A, 1.B, and 1.C) would, in all probability, be paid out of FFFF funds. The entire contract bid price did exist in the district budget. Based on this rationale, the contract was awarded to Cherub's Fire Control of Bend, OR, the low bidder. Table 2 displays the actual bid awarded.

Evaluating the Engines

As stated earlier, the comparative effectiveness of the contract initial action engines versus traditional staffing by Forest Service employees was a concern. Would contract engines perform as well as Forest Service staffed engines? Could they perform at a satisfactory level? The fire staff on the Deschutes National Forest measures the comparable performance of engine crews each summer by conducting an engine proficiency review. Since a mechanism existed to review proficiency, management decided to put the contract engine through the same drills as the Forest Service engines and let the fire staff objectively evaluate its

Table 1—*USDA Forest Service estimates for supplies, services, and costs when contracting for an initial action engine module*

Name of offeror or contractor: USDA Forest Service estimate					
Item No.	Supplies and services	Quantity	Unit	Unit price	Amount
1.A	One Type 6 engine with one engine boss and one crewmember June 24 to Sept. 28, 1991	77	Days	$160.00	$ 12,320
1.B	One additional crewmember to perform with engine listed in 1.A above from Aug. 1 to Sept. 28, 1991	25	Days	64.00	1,600
1.C	Mileage	6,750	Miles	0.45	3,038
1.D	Overtime	300	Hours	15.00	4,500
					$ 21,458

Table 2—*Low bidder estimates for supplying an initial action engine module*

Name of offeror or contractor: Bid award					
Item No.	Supplies and services	Quantity	Unit	Unit price	Amount
1.A	One Type 6 engine with one engine boss and one crewmember June 24 to Sept. 28, 1991	77	Days	$ 280.00	$ 21,560
1.B	One additional crewmember to perform with engine listed in 1.A above from Aug. 1 to Sept 28, 1991	25	Days	64.00	1,600
1.C	Mileage	6,750	Miles	0.40	2,700
1.D	Overtime	300	Hours	52.50	15,750
					$ 41,610

Table 3—*Evaluation of USDA Forest Service engines and the contract engine*

Engine proficiency review elements	Forest Service engine 1-5 (percent)	Forest Service engine 1-6 (percent)	Forest Service engine 1-7 (percent)	Contract engine 1-9 (percent)
Certification of crew	80	93	60	50
Safety	100	100	93	91
Strategy and tactics	83	92	92	58
Forest Service policy	100	100	100	N/A[1]
Vehicle equipment and maintenance	97	100	83	83
Map reading and compass use	67	56	56	22
Chainsaw safety	100	94	100	65
Tree felling and bucking	100	95	85	100[1]
Handtool use and maintenance	88	86	88	49
Hoselays and water use	80	100	100	—[2]
Total score, percent of maximum allowed	91.3	91.8	85.9	67.3

[1]Some review elements were not addressed in the contract specifications, so they were not included in the review for the contract engine. Two examples were "Forest Service Policy" and "Tree Felling and Bucking." A Forest Service officer was required to be the Incident Commander on all fires when the contract engine responded. Also the contract does not mention the felling of trees—and the contract engine was instructed specifically not to fell trees—therefore only the bucking of logs was included.

[2]There was not sufficient time to perform the hoselay drill on the contract engine.

performance, knowledge, and skill level. This evaluation occurred on July 19, just 7 days after the contract engine started work. The results of the testing are displayed in table 3.

Some general comments reflecting a tailgate analysis of the results were:

- The contract engine and crew performed at a significantly lower level than the engines staffed by Forest Service employees.
- The performance of the contract engine and crew was not considered to be unsafe, merely less efficient and less skilled.

It was not difficult to understand why the Forest Service engines scored much higher than the contract engine. The Forest Service engine crews had been working together for 4 to 6 weeks before the engine proficiency test, and many of them had worked together the previous fire season and were familiar with the drills. An interesting sidelight to the proficiency reviews—as the "permanency" of the engine leader's appointment deteriorated, so did the scores of the crews they supervised. Forest Service Engines 1-5 and 1-6 had leaders with permanent seasonal appointments, Forest Service Engine 1-7 had a leader with a temporary appointment and, of course, the contract engine had a leader with no appointment.

The 1991 fire season on the Bend Ranger District was moderately busy with 77 fires, 48 to which ground crews responded (29 fires were staffed with smokejumpers). The contract engine responded to and took suppression action on 14 fires for a total of 178 hours. While not actually fighting fire, the contract engine crew was involved in other resource-related operations such as road clearing, dispersed recreation patrol, and station maintenance.

The final payment document indicated that the contract engine worked a total of 86 days, 58 of which required a staff of three. They accumulated 9,552 miles (15,372 km) driven and 77 hours of overtime. The final cumulative payment total was $35,655. Of this, $8,748 was paid out of emergency firefighting funds (FFFF), and $26,907 was paid out of district project funds for interim fire protection.

As displayed in table 4, using the same days worked, miles driven, and overtime incurred, a similar Forest Service engine module would cost $26,645. In some situations dealing with a short work season, the contract engine option may offer more flexibility, but this may be at a reduced level of performance and usually at additional, up-front cost.

From the 1991 contract period, there have been no claims for damages or payment disputes filed against the Government by Cherub's Fire Control. All things considered, the cost of the services and equipment provided appears to have been reasonable.

The Evaluation: How Did It Work Out?

Contracting for an IA engine to be on duty at a designated station or work area, in lieu of the traditional method of hiring employees to staff Government equipment, appears to have been a reasonable alternative when stimulated by a need for workforce reduction. There are significant tradeoffs that must be seriously considered. Staffing a fire protection organization entirely with contracted engines is not recommended.

Reduced performance at higher cost can be expected, compared with traditional employee staffing of Government engines. It is not expected that the performance of the contract engine would increase significantly over time, unless the contractor has a stable program that

Table 4—*Costs of a Forest Service engine module[1] for the same period as the contract engine was used*

Supplies and services	Unit and cost per unit	Amount
Engine operator and crew leader (GS–5)	86 days x $95/day	$7,912
Skilled firefighter No. 1 (GS–4)	86 days x $62/day	5,332
Skilled firefighter No. 2 (GS–4)	58 days x $62/day	3,596
Overtime for above crew of 3	77 hours x $40/hour	3,080
Type 6 engine fixed operating rate	12 months x $250/month	3,000
Mileage cost	9,552 miles x $0.39/mile	3,725
Total comparative cost		$26,645

[1]All figures are based on actual 1991 costs incurred by the Bend Ranger District for similar equipment and staffing. When making cost comparisons, it is often difficult to include all the "hidden" costs associated with the Government workforce. Types of associate costs unaccounted for include: Unemployment costs for off-season firefighters, overhead costs associated with employment (payroll, per diem, office space, etc.), potential Office of Workers' Compensation Programs costs (a large, long-term expense if an injury occurred).

attracts the same firefighters to return each year. This, of course, is outside the control of Government management since the bid price generally controls which contractor would be hired.

Management flexibility was adequate with the engine contract, and in short season situations, may exceed that of Government crews. During short periods of low fire danger, the contract engine could be placed out-of-service for several days saving dollars for when it is needed during periods of higher fire danger. The contract engine could also be an attractive alternative when a protection organization needs to be "beefed up" when fire danger is expected to be at its worst.

The Deschutes National Forest has experienced a very high ratio of suspected arson fires to total human-caused fires over the past two fire seasons. None of these fires has yet to be attributed to an engine contractor. Investigations on many of these fires have been inconclusive in identifying an exact cause. Any attempt to determine a cause-effect relationship regarding the use of contract engines on the Deschutes National Forest with the frequency of suspected arson fires would be purely speculative.

Fire Season Update—1992

For 1992, the Bend District again hired a short-term 1A engine on contract for the fire season. The district revised the 1992 contract specifications based on what was learned in 1991. For example:

- **Tank design.** The new contract requires that tanks be baffled and the maximum capacity of the tank, when full, not exceed the gross vehicle weight (GVW) of the vehicle it is mounted on. The 1991 contract engine was mounted with a 300-gallon (1,136-L) unbaffled tank. The contract required a tank minimum capacity of 200 gallons (757 L). When the tank was filled with the higher amount of water, the GVW was exceeded. When the tank was filled with the lesser amount, the water shifted position, constantly changing the vehicle's handling characteristics. It also tended to make the vehicle "lurch" forward when the driver tried to make a quick stop. Both situations could lead to accidents in tight driving situations.
- **Equipment storage.** The 1992 contract requires a separate, dedicated storage compartment for hose. The wording in the 1991 contract did not require tools and hose to be stored in different compartments. Consequently, there were some hose failures because the hose rubbed against the metal parts of tools and other equipment and became worn.
- **Proficiency examination.** Before being certified as meeting the requirements for the positions of firefighter and engine boss, all potential contractor employees must pass a proficiency exam. Contractors were considered nonresponsive if they submitted bids without having sufficient qualified personnel (who had passed the exam) to staff the engine to contract specifications.

The 1992 contract was again awarded to Cherub's Fire Control with the low bid of $35,753.04.

Further information on the contracting of a full-time 1A engine can be obtained by contacting Mark Beighley, (503) 388-5664 or Dan Parazoo, contracting officer, Deschutes National Forest, (503) 388-2715. ■

Pump and plumbing configuration on Type 6 Cherub's Fire Control engine.

For Exceptional Forest Fire Prevention Efforts: The Golden, Silver, and Bronze Smokey Bear Awards

Every year, the Cooperative Forest Fire Prevention Program Executive Committee selects winners for the USDA Forest Service Cooperative Forest Fire Prevention awards—the Golden, Silver, and Bronze Smokey Bear Awards. These awards are the highest forest fire prevention awards given through the Forest Service. Only three Golden, five Silver, and ten Bronze Smokey Awards can be awarded each year. Each recipient receives a golden, silver, or bronze statuette of Smokey Bear.

The Golden Smokey Bear Awards. The Golden Smokey Bear Awards are presented by the Chief of the Forest Service in the Washington Office to individuals or organizations that make significant national contributions to the prevention of forest fires over a 3-year period. For 1991, two Golden Smokey Bear Awards were given—one to a business and the other to a professional association:

- The Nelson/Weather-Rite Company: Sponsored and promoted the Junior Forest Ranger Program, Outdoor Fire Safety, and the Smokey Bear symbol, increasing the visibility of these programs.
- The Professional Rodeo Cowboys Association: Sponsored the Smokey and the American Cowboy Program, which is now active on both the East and West Coasts.

Silver Smokey Bear Awards. The Silver Smokey Bear Awards are presented by the Regional Forester or State Forester, or a representative of either, at various special events. These awards are presented to individuals or organizations that have made outstanding regional or multistate contributions in forest fire prevention programs over a 2-year period. The five 1991 recipients were the following:

- The Weyerhauser Company's Oklahoma-Arkansas Timberland Areas for their financial and personnel contributions in delivering the fire prevention message to southeast Oklahoma and southwest Arkansas.
- The San Diego Padres for their public service advertising contributions across all media as well as the annual San Diego Padre-Smokey Bear Fire Prevention Night.
- The Oakland Athletics for their multimedia public service advertising contributions and the sponsorship of the annual Oakland Athletics-Smokey Bear Fire Prevention Night and the Firefighter Appreciation Night.
- The California Angels for their contributions of multimedia public service advertising and the sponsorship of the annual California Angels-Smokey Bear Fire Prevention Night.
- The Fire Prevention Committee of the Sierra Front Wildfire Cooperators for their long-term interagency efforts in fire prevention along the Sierra front.

Bronze Smokey Bear Awards. The Bronze Smokey Bear Awards are presented at special ceremonies by the Regional Forester or State Forester, or a representative of either. These awards are given to organizations or individuals that have provided outstanding statewide service in wildfire prevention for a minimum of 2 years. There were eight award recipients in 1991:

- Rebecca Cabe of the Georgia Forestry Commission for her development and presentation of fire prevention programs used throughout the State with civic and church groups, her news articles, and her radio spots.
- The Florida Arson Alert Association for their efforts to inform the public about woods arson and for creating a funding system to pay rewards for information leading to the arrest and conviction of woods arsonists.

Left to right, Forest Service Chief F. Dale Robertson, Professional Rodeo Cowboys Association Commissioner Lewis Cryor, Smokey Bear, Nelson/Weather-Rite President Steven Cohen, and Nelson/Weather-Rite Chief Executive Officer Melvin Marx.

Regional Forester Ron Stewart, Region 5, presenting the Silver Smokey Bear Award to California Angels' director of marketing and promotions, Bob Wagner.

- James M. Dale, Tennessee Department of Agriculture, Division of Forestry, for creating and implementing a statewide burning permit system for trash and debris burning and soliciting Nashville personalities to produce fire prevention public service advertising to explain the message.
- Betty Sutton, Texas Forest Service, for her work with school programs in fire prevention and safety, creating a puppet show including puppets and audio that has been used widely in the State.
- James Whitson, Florida Division of Forestry, for implementing an interagency fire reduction initiative in each of the 17 districts of the Florida Division of Forestry.
- Charles Schultz, Utah Division of State Lands and Forestry, for his outstanding efforts in fire prevention education.
- Joseph R. Hughes, New Jersey Bureau of Forest Fire Management, for his long-term creative contributions to fire prevention, special prevention activities, and public service advertising with the Middle-Atlantic Interstate Forest Fire Protection Compact.
- Richard Just, for his personal initiative in development of a traveling Smokey Bear museum, used in California as a fire prevention tool at special events.

Remember To Nominate. Many people and organizations are doing wonderful things in forest fire prevention across the Nation. Don't forget to nominate someone through your Regional Forester when the call letter comes out in August. ■

Tammy J. West, *program specialist, USDA Forest Service, Fire and Aviation Management, Cooperative Forest Fire Prevention Program, Washington, DC*

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